ATER and RELATED LAND RESOURCES
UMBOLDT RIVER BASIN
NEVADA

REPORT NUMBER SEVEN

ELKO REACH

APRIL, 1964

Based on a Cooperative Survey

by

THE NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

and THE UNITED STATES DEPARTMENT OF AGRICULTURE

Prepared by

Economic Research Service - Forest Service - Soil Conservation Service

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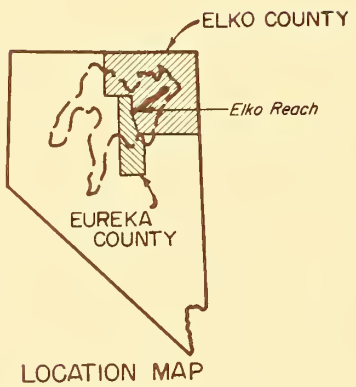

LOCATION MAP

LEGEND

Sub-Basin Boundary

County Boundary

COVER PHOTOGRAPH

Aerial view of Elko, looking westerly. The location of the town with relation to highways, the municipal airport, and the two railroads is clearly shown. On the left the Humboldt River is seen, with its willow-lined channel winding through hay meadows and pastures.

EARL FRANTZEN PHOTO

USDA SCS PORTLAND OREG. 1964 M-4086

REGISTER

REPORT NUMBER SEVEN
ELKO REACH
APRIL 1964

Will you please detach and fill out this form; mail it to us, so that we may send you any additions, changes, or corrections.

Humboldt River Basin Field Party
P.O. Box 982
Elko, Nevada 89801

Name _____

Address _____

_____

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REPORT NUMBER SEVEN

HUMBOLDT RIVER BASIN

NEVADA

ELKO REACH

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Forest Service - Soil Conservation Service
Economic Research Service

April 1964

FOREWORD

This is a report for the people of Nevada, and particularly for the people of the Humboldt River Basin, concerning water and related land resources in the Elko Reach.

It is the seventh of a series of reports which will result from a cooperative survey of the Humboldt River Basin by the Nevada State Department of Conservation and Natural Resources and the U.S. Department of Agriculture. It was prepared by the Soil Conservation Service, the Forest Service, and the Economic Research Service of the Department of Agriculture.

The State of Nevada seeks constantly to assist local people and their organizations in the conservation, development and management of water resources. It has particular regard for the relationship of water to land and to human resources. This is exemplified by the creation of the Nevada State Department of Conservation and Natural Resources. A primary responsibility of that Department is to cooperate with Federal agencies and local groups, and to coordinate State-Federal activities that help solve water and related land problems for the people of Nevada.

The responsibilities of the Nevada State Department of Conservation and Natural Resources, and the cooperative research work already under way in the Humboldt River, set the stage for Federal-State cooperation in developing information on opportunities for improving the use of the land and water resources of the Basin. Accordingly, cooperation was initiated with the U.S. Department of Agriculture under a Plan of Work dated June 3, 1960, with agencies of the Department and of the State of Nevada participating in the survey. It is important here to point out that responsibility for matters concerning State water rights and determination of water supply as it might affect State water rights was assumed by the State of Nevada.

This cooperative survey of the Humboldt River Basin is for the primary purpose of determining where improvements in the use of water and related land resources, some of which have social and economic aspects, might be made with the assistance of projects and programs of the U.S. Department of Agriculture. A major part of the survey is focused on situations where improvement might be brought about by means of Federal-State-local cooperative projects developed under the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress as amended). This survey is in keeping with long-established tradition in the Department of Agriculture of cooperation with States and local entities in the conduct of its work. Further, such cooperation is a most important responsibility of the Nevada State Department of Conservation and Natural Resources.

The U.S. Department of Agriculture-State of Nevada Plan of Work in the Humboldt River Basin offers opportunities for participating in the survey by other Nevada State agencies and Federal agencies. The Bureau of Land Management, as an example, has cooperated with respect to the national land reserve. Thus, the survey is not limited, but is, rather, as broad in scope and agency participation as is required to meet the agreed-upon objectives.

The entire Humboldt River Basin is being studied by segments identified as sub-basins or reaches. This report contains much information for study and use in understanding and solving some of the existing water and land resource problems in the Elko Reach. The report presents opportunities for Federal-State-local project-type developments under the Watershed Protection and Flood Prevention Act, together with other opportunities for development and adjustment.

I wish to recognize the excellent work of the U.S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources in this cooperative effort. I consider that this report will serve the best interest of the people in the Humboldt River Basin and the State of Nevada.

Governor of Nevada

HUMBOLDT RIVER BASIN SURVEY

ELKO REACH REPORT

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ORGANIZATION OF REPORT

The report on the Elko Reach is divided into three main sections. The first section is an overall report on the reach; the remaining two sections consist of Appendix I and Appendix II, respectively.

Appendix I is attached to all the report copies, and contains pertinent textual matter concerning the reach which is of value to the general reader.

Appendix II is produced in a relatively limited number of copies. Its small appeal to the general reader renders it unsuitable for inclusion with the report copies for general distribution. However, this type of material does have potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Elko Reach. Copies of this appendix are available upon request.

SUMMARY

The Elko Reach comprises the Humboldt River bottomlands between Deeth and Palisade and the small drainages which discharge directly into the Humboldt River. The total area is about 310,000 acres or 484 square miles. Approximately 43 percent of the land is Federally owned and 57 percent is in private ownership.

Every era and phase of the white man's period of use or occupancy of the Humboldt Basin has been represented within the narrow confines of this reach of the river. Starting with the fur trappers in 1828, its history extends through the period of the emigrant wagon trains, which started in 1843, and the freight and stage lines, about 1868, to the present-day ranching industry.

Agriculture started about 1868 with the raising of hay and grain to feed the enormous numbers of draft and pack animals used for the pack strings and to pull the freight wagons and stages. Later, as the mining districts began to decline, great numbers of Texas longhorn cattle were brought in to feed on the lush ryegrass in the meadows and the bunchgrass on the upper slopes.

The towns of Elko, Carlin, and Palisade began as headquarters for the freight and stage lines and, in the case of Carlin, as a division point on the Central Pacific Railroad. Today the City of Elko (population 6,298, 1960 census) is not only the headquarters for the ranching industry, but is becoming of increasing importance as a center of recreation for northeast Nevada. It is also a division point for the Western Pacific Railroad. Carlin (population 1,023, 1960 census) is a division point for the Southern Pacific Railroad, and Palisade has been reduced to an ore and stock-loading point on the railroads.

The big sagebrush-grass type constitutes the predominant plant cover over much of the reach, giving way to scattered stands of juniper-pinyon south of the Humboldt and a few isolated stands north of the river. Aspen are found in the upper basins of Sherman, Kittridge, and Jackstone Creeks. Considerable bitterbrush is present in the unburned areas of the sagebrush type on the Adobe Range. From Deeth westward to Palisade, irrigated meadow and alfalfa hayland and semi-irrigated pastureland interlaced with willows and phreatophytic greasewood and rabbitbrush occupy the bottomland. The phreatophytes are found throughout the reach, with greasewood dominant, generally forming a fringe to the meadow bottomland. The only rubber rabbitbrush stands of appreciable size are found near Osino and the Nevada Youth Training Center, and along Marys Creek. Also along the bottomlands are fringe fenced areas of Great Basin wildrye which give considerable winter forage to livestock.

Livestock raising, almost exclusively cattle at this time, is the dominant agricultural activity. Within the reach there are 22 range livestock ranches; of that number, 13 have headquarters in the reach. Privately owned lands are used for the production of irrigated crops and range forage. The national land reserve (formerly public domain) is used primarily for spring-fall and summer range for livestock. Portions also serve as winter range, primarily, for big game, and as a year-long habitat for other wildlife forms. There are no national forest lands in the Elko Reach.

Of the 295,800 acres of usable range land, approximately 251,400 acres are currently in the low forage production class, 41,100 in the medium class, and 3,300 are in the fairly high forage production class. Livestock numbers on ranches headquartered in the reach, based upon Bureau of Land Management licenses for 1963, were estimated at 9,250 head of cattle. The Federal range provides less than half of the spring-fall and summer feed required; the Federal and intermingled private range lands furnish approximately 6,700 A.U.M.'s of forage. Practically all this use is in conjunction with the use of national land reserve range in adjacent sub-basins. The balance of feed is provided by two or months' grazing on private range land, crop aftermath, adjacent native irrigated pasture, and three to four months on hay.

According to the Census of Agriculture, since 1929 the number of ranchers owning all the private land they operate averages about 75 percent in Elko County. The percent of full owner-operators decreased from 81 percent in 1949 to 71 percent in 1959. Assuming the same trend as in Elko County, the number of ranches in the reach decreased more than one-half during the period 1934 to 1959, and the average size of ranches has increased during the same period.

The number of commercial ranches having sales of agricultural products in excess of $20,000 has increased from seven percent in 1939 to 35 percent in 1949, and to 67 percent in 1959.

Average annual precipitation varies from around seven inches at Carlin to 10 inches at Deeth. Average frost-free period (28 degrees F) for the irrigated lands varies from 90 days at Deeth to 120 days at Carlin.

Practically all the water available to this section of the Humboldt River originates outside the boundaries of the reach. The annual water balance studies made by the Field Party indicate that during an 80 percent frequency flow year the gross water yield is negligible (estimated 500 acre-feet) when compared to the flow of the Humboldt River. Water used in the reach amounts to an estimated 27,500 acre-feet, which includes 6,900 acre-feet by phreatophytes, 19,600 acre-feet by irrigated crops, and 1,000 acre-feet for municipal use. There are an estimated 4,000 acre-feet lost by direct evaporation from surface water during periods of high flow.

Most of the hay lands and phreatophyte areas are located along the valley bottomlands. These fields of native hay and pasture are irrigated continuously during the period of high seasonal stream flow. A small acreage of improved land above the flood plain of the river receives water at periodic intervals from springs, when available. On-the-farm irrigation efficiency is quite low; it is estimated at 20 percent or less on most fields.

There is a small amount of improved irrigation development in the area, consisting of land leveling, land smoothing, diversion structures, spreader ditches, and four wells. Most of the irrigation is done by a semi-controlled type of wild flooding. Of the other methods, limited use has been made of border irrigation. Water supplies from surface streams vary widely throughout the irrigation season, which makes water regulation difficult. Water is generally kept on the fields much longer than is needed; this results in low

irrigation efficiency, loss of fertility, and lower yields.

The principal soil problems on irrigated cropland are high water table, poor drainage, lack of fertility, overflow, and salt and alkali concentrations. These problems usually occur in Humic Gley Soils found in the flood plain of the river.

Since 1870, the earliest year of recorded flood damage on the Elko Reach, there have been 12 wet-mantle floods and three dry-mantle floods which have caused major damage, loss of human life, or both. The damages have resulted from watershed erosion, stream and gully erosion, and cropland sedimentation. The losses have been incurred from impairment to irrigation installations and human and livestock injury or death. Damages have also been inflicted on roads, bridges, buildings, and railroad installations and facilities along the entire reach, from Deeth to Palisade.

Regular Department of Agriculture and other Federal and State programs can provide assistance in accomplishing many needed improvements in the reach. Regular programs of the Bureau of Land Management, including fire protection, provide for the protection and improvement of the Federal lands which that agency administers, within the scope of currently available funds.

A review of the reach indicates that the water and related land resource problems in one watershed are such that they can best be handled on a project basis. In this area, improvement measures can be installed which will provide for flood prevention, watershed protection, increase range forage production, enhance recreation opportunities, supply supplemental municipal water, and reduce erosion and sediment damage. A preliminary evaluation of the works of improvement proposed for the watershed area is sufficiently favorable to warrant a more detailed study of the possibility of a watershed protection and flood prevention project.

HUMBOLDT RIVER BASIN SURVEY

ELKO REACH REPORT

AUTHORITY AND ORGANIZATION

The need for continually improving the conservation and use of water and related land resources has long been recognized by Federal, State, and local agencies. A recent pertinent development of this continuing interest is River Basin studies under Section 6 of Public Law 566, as amended and supplemented. In Nevada such a survey is underway by the U. S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources.

The Secretary of Agriculture is authorized under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act to cooperate with other Federal and with State and local agencies in making investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs.

General direction for the U. S. Department of Agriculture in the conduct of the studies and preparation of the report was provided by a USDA Field Advisory Committee composed of representatives of the Soil Conservation Service, Forest Service, and Economic Research Service. The USDA River Basin Representative served as advisor and consultant to the Committee.

General direction for the State of Nevada was provided by the Director of the State Department of Conservation and Natural Resources.

A Field Party, composed of representatives of the Soil Conservation Service, the Forest Service, and the Economic Research Service, completed the field work and prepared this report.

Grateful acknowledgement is made to all individuals and to the personnel of other State and Federal agencies who gave their counsel and technical assistance in the preparation of this report.

HISTORICAL INFORMATION

Settlement

Because this reach of the Humboldt main stem typifies the essence of Dale Morgan's description of the Humboldt as "the highroad of the West", every era and phase of the white man's period of use or occupancy of the Humboldt Basin has been represented within its narrow confines. Here trappers, both British and American, scoured its meadows and marshes for beaver and other fur-bearers. Here long dust-choked trains and emigrant wagons rolled, and huge "sagebrush clipper" freighters plied their way, pulled by strings of horses, oxen or mules, along with the swaying Concord coach and its four or six-horse teams of fast horses.

With advent of the Central Pacific Railroad, and development of Elko, Carlin, and Palisade as freighting and staging gateways for mining districts north and south of the railroad, establishment of the ranching industry began. At first, these ranches were merely adjuncts to the freighting and staging lines, raising hay and grain needed to feed the enormous numbers of draft and pack animals used for pack strings and to pull freight wagons and stages. Livestock were also raised to supply meat for the mining districts. Later, as the mining districts began to decline, and traffic between them and the railroad shipping points lessened, great numbers of Texas longhorn cattle were brought in to feed on the lush ryegrass in the meadows and bunchgrasses clothing the benches and upper slopes.

Finally, development of the motor car led to the conversion of the old emigrant, freighting, and staging routes into the present network of modern through highways and secondary feeder roads.

Peter Skene Ogden and his Hudson's Bay Company Snake Country Brigade were the first white men to enter the area. Traveling up the Humboldt they entered the Elko Reach at Palisade early in December 1828, probably passing the site of present-day Elko on December 12. On this, the fifth of his Snake Country Expeditions, Ogden had been ordered to trap out streams as he went, leaving a "fur desert" for American fur companies and free trappers, to discourage them from any further thrusts westward.

After wintering in Ogden's Hole, near Huntsville, Utah, Ogden, retracing his December 1828 route, re-entered the Humboldt Basin through Secret Pass, and reached the Humboldt in April 1829 near Halleck and left it by way of Maggie Creek a few days later.

One more trapping foray was made into the upper Humboldt country by the Snake Country Brigade, then under the command of John Worth, in the spring of 1831.

The last large scale exploitation of the Humboldt's by then scanty fur resource occurred in 1833-34. The Bonneville-Walker party of American fur trappers traversed the full length of the Humboldt west in August-September 1933, and on the return trip eastward in June 1834, to their rendezvous on Bear River with Captain Bonneville. The party diverged from their westbound route at Deeth, proceeding up Bishop Creek on June 21, 1834, and out of the Humboldt Basin into Thousand Springs Valley.

COURTESY ELKO INDEPENDENT

This return trip is of interest here because Walker and J. B. Chiles used the route in 1843 laying out the wagon trail for the Walker-Chiles party. This was the first of myriads of wagon trains which would traverse the same route to and along the Humboldt Valley for the next 27 years (1843-1870) on the California Emigrant Trail.

Construction of the Central Pacific Railroad through the reach from November 1868 to January 1869 brought the major covered wagon period of emigration to a close, although considerable wagon travel on the California emigrant trail occurred as late as 1875. With arrival of the railroad, there began the era of the toll, freighting and staging roads reaching out from the rails at Elko, Carlin, and Palisade to mining camps north and south of the Elko Reach.

Carlin was reached by the Central Pacific in early December 1868. It became the eastern terminus of the Humboldt Division, and a townsite was laid out. The new town entered into active competition with Elko for the Railroad District, Mineral Hill, Eureka, White Pine, and Austin freight and stage business, with completion of a bridge south across the Humboldt about August 1, 1869, and construction of toll roads to these points.

The Elko townsite, terminus of the Hill Beachey and Elko-White Pine Toll Roads, was laid out by the Central Pacific shortly after it reached there, on December 20, 1868. Lots in the townsite were first put up for sale on January 15, 1869. (See photograph 1, old sketch.)

The Western Union Telegraph line, paralleling the railroad, was completed to Elko from the west on July 8, 1869, and was joined with the line east at Promontory, Utah on August 28. Transcontinental telegraph traffic was then switched to this line from the Salt Lake City-Sacramento Overland Telegraph Lines through Overland Pass.

Palisade (first named Palisades) was not laid out at the time the Central Pacific built through Palisade (Twelve Mile) Canyon, in November 1868. Len Wines and Frank Denver were both eager that a townsite be laid out there, as they wished to establish the

Photograph 1. - Line drawing of Elko and the Humboldt Valley in the early 1880's, looking northeast toward Up River Peak (Elko Mountain), the high peak on the right. Those familiar with the Elko of long ago will recognize the Hot Hole and the Elko-White Pine Road, the Denver Bridge, the Central Pacific Depot and Hotel, the Courthouse, the original University of Nevada buildings, and others.

Photograph 2. - Palisade on a summer morning around the turn of the century, looking northeasterly up the Humboldt. All the buildings in the picture have long since vanished. The tri-weekly narrow-gage Eureka & Palisade mixed train is preparing to leave the E.&P.-S.P. passenger depot for Eureka. In the middle distance are the S.P.-E.&P. freight houses, and behind them the E.&P. roundhouse and shops. Practically all the buildings between the railroad and the river were washed away in the February-March 1910 wet-mantle flood, or destroyed in the July 1910 fire. NEVADA HISTORICAL SOCIETY PHOTO

terminus of their projected rival toll roads through Pine Valley from the White Pine mining district at that point. However, the Central Pacific refused to do so, because of the necessarily constricted nature of any townsite in Palisade Canyon, and also because the railroad wished its division point of Carlin to become the principal terminus for roads to these southern mines. Wines and Denver thereupon settled upon Elko as the next best terminus for their toll roads.

After emergence of the Eureka district and Mineral Hill as premier producers of lead and silver in late 1868 and 1869, however, natural advantages of the Palisade site as a freight and passenger terminus were not to be denied. By January 15, 1870, the railroad had completed freight loading platforms there, and appointed a resident freight agent. During the last week of February, Central Pacific engineers laid out a townsite and the sale of lots commenced. By May 1, 1870 a new passenger depot and hotel were opened for business there. (See photograph 2.)

The "sagebrush clipper" freight wagon and the stagecoach reigned supreme on the Palisade-Pine Valley-Eureka scene from June 1870 until the construction of the Eureka & Palisade Railroad in 1873.

The Central Pacific, western half of the original transcontinental main line, remained as the only east-west railroad through the Elko Reach until the completion of the Western Pacific Railroad in November 1909. After 1899, the Central Pacific was controlled by the Southern Pacific, and gradually became absorbed by that parent company. Under the new management, extensive line-straightening changes were made along the system from 1901-1903, which resulted in material improvement in freight and passenger service. Through freight service was inaugurated over the Western Pacific on December 1, 1909, and through passenger service on August 22, 1910. There has been continued improvement in service on both railroads through the years with the development of improved motive power and rolling stock.

The route of the old California Emigrant Trail through the Elko Reach remained practically unused after 1875, until the coming of the automobile age in 1913. At that time, sections of the old trail were pieced together with abandoned stretches (1901-1903), of the original Central Pacific roadbed. This combination was designated as U. S. Route 1 in Nevada. (Carlin Canyon, from Moleen to Carlin, was the principal Central Pacific section in this reach converted to auto highway.) Route 1 became the Victory Highway in 1920, and in February 1921, construction of a highway to uniform standards on this route was begun in Elko County. In 1926, following the nation-wide change of highway names to numbers, the Victory Highway became Highway 40. It was paved in the 1930's and relocated and repaired in many stretches in 1941-42, particularly over Emigrant Pass. At this writing, the stretch from six miles east of Elko to four miles west of Deeth is being reconstructed and converted into Interstate 80.

Metal mining, as such, has never been of any consequence in the Elko Reach, although mills and smelters have been constructed at various times to process ores from the adjoining mining districts.

In the field of non-metallic mining, lignite and oil shale beds along the Humboldt River, from Elko to Carlin, were the scene of sporadic mining and drilling activity from 1869 to 1923. However, no commercial quantities of oil have ever been profitably produced.

First agricultural use of the reach started, as previously stated, with the raising of hay and small grains to feed the great numbers of livestock used in handling freighting and staging traffic to all mining districts lying north and south of Elko, Carlin, and Palisade. A flour mill was established at Elko in 1875, to process grain grown in adjacent valleys. However, by this time the raising of livestock, primarily cattle, had become dominant here. Carloads of cattle were being shipped at Carlin, Elko, and Deeth from ranches in and around the reach.

Many large ranches operated along the reach, starting in the 1870's, including the firms of Bradley and Russell, 1871; J. R. Bradley and Sons, its eventual successor (1897),

which was originally formed in 1873; Mason and Bradley, 1885; Henry Moffat and associates, 1916 (Nevada Land and Livestock Company, and later, 1917, the Union Land and Cattle Company); Henry Moffat Company, 1925; and the Hunter and Banks Ranch, 1910 (present McKinley Land and Cattle Company).

All these early large livestock ranches have long since been broken up into smaller operations, although several ranches in the reach and surrounding area are still relatively large.

The City of Elko has developed into its present cardinal importance as the eastern Nevada livestock and supply center for two important reasons:

1. Its strategic geographical location as the outlet point on the railroad for a vast territory stretching to the north and south brought about its development, in the natural course of events, as a major shipping center.

2. The large expanse of natural meadows producing hay and pasture along the adjacent reaches of the Humboldt, with extensive areas of good rangeland surrounding it on all sides, influenced the development of Elko and its environs as the center of a large and flourishing cattle industry.

A managed grazing program on national land reserve (public domain) lands in the Elko Reach was not begun until establishment of the Grazing Service, now the Bureau of Land Management, in the Department of the Interior in 1935. At that time the Elko Grazing District was established to manage these lands.

Three soil conservation districts, Starr Valley, Humboldt River, and Jiggs, operate in the reach, and provide assistance to ranch operators in the conservation and development of soil, water, and range resources on privately owned lands. The Starr Valley was organized in February 1946, the Jiggs in March 1950, and the Humboldt River in September 1950.

Floods

In common with the rest of the Humboldt Basin, the Elko Reach has been subjected to recurrent periods of flooding and high water. The earliest recorded flood year along the Humboldt main stem was 1862; however, since this flood was prior to the earliest period of settlement on the upper Humboldt, there are no records of damages.

For further information on history of floods and high water periods on the Elko Reach, refer to the section on flood damage.

Fires

Within the past 25 years, two fires have been large enough and severe enough to be significant causative agents of watershed damage. The first fire, in late June 1939,

was caused, ironically enough, by CCC crews undergoing fire suppression training; it burned an estimated 5,000 acres. Second and by far the more severe of the two fires was the Elko fire of July 8-11, 1947. The fire, lightning-caused, burned more than 100,000 acres of sagebrush-grass range and watershed lands. Virtually all the burn was within the boundaries of the Elko Reach, north, west and east of Elko, on the south exposure of the Adobe Range, from East Adobe to Jackstone (Jackson) Creeks. For a time it threatened Elko itself, and only strenuous work on the part of the fire crews kept it out of the town. Over 20 miles long and from five to 15 miles wide, it was the largest fire in the recorded history of Elko County.

POPULATION

Elko (population 6,298, 1960 census) and Carlin (population 1,023, 1960 census) are the principal supply centers for the people in the Elko Reach.

Elko is becoming of increasing importance as a center of recreation activity for northeast Nevada. Its population has been increasing uniformly, averaging 1,000 every 10 years over the past three decades.

Carlin's population has fluctuated in relation to the activities of the Southern Pacific Railroad. The trend has been downward in the past 10 years.

	1930	1940	1950	1960
City of Elko	3,217	4,094	5,293	6,298
Carlin	825	832	1,203	1,023

PREVIOUS STUDIES

Technical reports covering limited or specialized fields have been made at various times in the reach. Their titles are listed in the Reference section of this report.

GENERAL REACH CHARACTERISTICS

The Elko Reach comprises the Humboldt River bottomlands between Deeth and Palisade, and small drainages that discharge directly into the Humboldt River. The total area is about 310,000 acres, or 484 square miles. It includes such drainages as Waiter Creek, which discharges into the Humboldt from the north about five miles southwest of Deeth; Jackstone (Jackson), Sherman, Kittridge, Eight Mile, and other creeks which drain the south slopes of the Adobe Range. In addition it includes Marys Creek, which drains the south slope of Marys Mountain west of Carlin; Woodruff, Tonka, and other creeks which drain the north slopes of Buckskin Mountain, Grindstone Mountain, and the Elko Hills.

Throughout this reach three physiographic land forms are well developed: Mountain highlands, valley uplands, and valley lowlands. Bedrock is exposed or lies at shallow depths in the mountain highlands, as found on Marys, Buckskin, and Grindstone

Mountains and the Adobe Range. The north flank of the Elko Hills and the benches between the Adobe Range and Humboldt River are part of the valley upland. An abrupt change in slope often occurs between the steeper highlands and the more gently sloping uplands. This break occurs at an elevation of about 6,000 feet on the flank of the Adobe Range. Dissected erosional surfaces forming part of the uplands, such as the tops of the benches northwest of the City of Elko, are graded to former stable elevations of the river. Except for a thin veneer of more recent deposits, the uplands are largely underlain by deposits of Tertiary age. The lowlands include the flood plain and low terraced land along the river. Average gradient of the valley bottom is about nine feet per mile, and the width ranges from a few hundred feet to three-fourths of a mile.

Geology

Valley fill deposited during Quaternary time includes mostly unconsolidated channel, flood plain, and terrace alluvium. Also present are wind-blown, alluvial, and colluvial deposits. Near Elko maximum thickness of these deposits is not more than 75 feet. Older valley fill underlying the Quaternary deposits are partially consolidated sediments of Tertiary age. These deposits are several thousand feet thick, and consist mostly of alluvial, stream and lake sediments and interbedded volcanic materials.

Consolidated bedrock, mostly of Paleozoic age, underlies the partially consolidated Tertiary deposits. This bedrock crops out in the mountain highlands and includes shale, slate, limestone, quartzite, chert, conglomerate, sandstone, dolomite, and altered volcanic rock.

Basin and range block faulting, occurring in Tertiary and Quaternary times, is responsible for the dominant structural features in the area. Minor folding and small scale faulting also occurred during the same period. The general trend of this faulting is north to northeasterly. Normal faults occur along the northwestern margin of Grindstone Mountain and Elko Hills.

Ground Water

The valley fill receives ground water recharge from two sources: (1) direct infiltration of water from the Humboldt River; (2) ground water moving downgradient toward the Humboldt from infiltration areas at higher elevations.

Between Ryndon and Carlin Canyon, paralleling the Humboldt River, the Adobe Range on the north and the Elko Hills and Grindstone Mountain on the south are believed to form a barrier to most ground water underflow from the valley fill. These ridges consist largely of consolidated rock. At the Carlin Canyon narrows the confined underflow moves through (1) thin unconsolidated alluvium blanketing the bedrock, (2) joints, fractures, and other openings in the bedrock, or (3) is forced upward to discharge as surface flow. (See photograph 3.)

Between the lower end of Carlin Canyon and Palisade Canyon, Pliocene, Miocene, and other Tertiary beds generally dip east (less than 35 degrees), which is adverse to the ground water underflow moving westerly. Eastward tilted volcanic rock of the Cortez Mountains on the south of the river and consolidated rocks of the Tuscarora Mountains on the north block most underflow from the valley fill, except for that moving through joints, fractures, and other openings.

The best source of ground water in the vicinity of Elko is from aquifers in the deposits of Tertiary age. Generally, wells with moderate to high yields intercept aquifers at depths below 400 feet. These aquifers consist of imperfectly interconnected lenticular beds of poorly sorted sand and gravel.

Soils

The soils have developed mostly from Quaternary or Tertiary stream and lake deposits. (See Soils Description and tables 6 and 7, Appendix I.)

Soils in the valley uplands are mostly moderately deep to deep, medium and stony or gravelly medium textured, well to excessively drained, and have none to slight salt and alkali concentrations. About 10 percent of these soils are shallow and are excessively drained, and about three percent are moderately well drained, with strong alkali concentrations in the subsoil.

The flood plain soils are deep, medium to moderately fine textured, imperfectly to poorly drained, and have none to moderate salt and alkali concentrations.

Photograph 3. - Carlin Canyon of the Humboldt, between Elko and Carlin, looking southwest. The ridges of consolidated rock forming the canyon walls on each side are believed to form a barrier to most ground water underflow. U.S. Highway 40, shown here, soon to be rebuilt into Interstate 80, rests upon the grades of two earlier auto highways, the original Central Pacific Railroad grade (see pages 4 and 5), and the California Emigrant Trail. Through the years, the defile has also been known as Fremont Canyon and Moleen Canyon. FIELD PARTY PHOTO 6-788-3

Precipitation

Precipitation on the irrigated land is estimated to vary between seven inches around Carlin to 10 inches at Deeth. In the mountain highlands, above 6,000 feet in elevation, the precipitation is estimated to vary between nine and 15 inches.

Average annual precipitation at points in and around the reach, as determined from the U.S. Weather Bureau records, is as follows:

Station	Ave. precip.	Elevation	Years of record
Wells	9.7	5,633	55
Deeth	9.7	5,343	10
Halleck	8.1	5,229	33
Elko	8.6	5,075	93
Carlin	7.1	4,900	31
Palisade	8.7	4,821	24
Emigrant Pass Highway Sta.	8.9	5,760	9
Beowawe	6.5	4,695	92
	Storage Gage		
Adobe Summit	9.2	6,560	9

Growing Season

Average growing season for stations in and adjacent to the reach, as determined from the U.S. Weather Bureau records, is as follows:

Station	Growing season (28°F)	Years of record
Wells	85 days	9
Deeth	85 days	8
Elko	116 days	41
Beowawe	123 days	38

From these data the growing season (28 degrees F) is estimated to vary between 120 days at Carlin to 90 days at Deeth. A longer season at Deeth is indicated from interpolation of data from the longer period of record at Elko. The average annual temperature varies from about 49 degrees F at Beowawe to about 44 degrees F at Deeth.

General Cover Types

Big sagebrush (Artemisia tridentata) and cheatgrass (Bromus tectorum) constitute the predominant plant cover over most of the upland benches and terraces and intermediate mountain slopes of the reach. Within this type are two sub-types -- low sagebrush (Artemisia arbuscula-Artemisia nova) and juniper (Juniperus utahensis).

The low sagebrush type is found on the upper elevations of the Adobe Range and Elko Mountain (Up River Peak). Stringers and islands of this type can also be found along Jackstone and Sherman Creeks, and on and around Buckskin Mountain.

The juniper type occupies the low rolling hills south of the Humboldt River from Elko Mountain to the rolling uplands west of Grindstone Mountain. A small amount of single-leaf pinyon pine (Pinus monophylla) is found with the juniper on Grindstone Mountain. North of the Humboldt River small islands of juniper are present near the ridgetops from Carlin Canyon to Sherman Creek (see photograph 4). A few groves of quaking aspen (Populus tremuloides) are also found on the north side of the river in the upper basins of Sherman and Jackstone Creeks.

The bottomland along the Humboldt River consists chiefly of irrigated and semi-irrigated hay and meadow land, and adjacent unirrigated land with a cover of shrubs and grasses. Approximately 900 acres of native meadowland have been leveled and planted to alfalfa. An additional 2,500 acres of hayland have been improved through better irrigation water control, and the planting of better species of forage plants. Stringers, clumps, and islands of willows (Salix spp.) are found throughout the bottomlands, particularly above the confluence of the South Fork of the Humboldt River and the main river.

Photograph 4. - Small islands of Utah juniper in the big sagebrush-grass type north of the Humboldt River, 10 miles west of Elko. S.C.S. PHOTO 6-313-4

Photograph 5. - Clumps and islands of willows scattered through the hay meadows along the Humboldt at Ryndon, east of Elko. Fringing the meadows, along the old Central Pacific grade in the foreground, is a stand of rabbitbrush, with some greasewood. FIELD PARTY PHOTO 6-773-1

Many of the willow stringers are along natural water courses or irrigation ditches. The islands or clumps of willows are usually found next to the Humboldt River channel, and offer considerable protection against bank erosion and undercutting during high runoff periods (see photograph 5).

The river bottom land which is not hayland, grass pasture, or willows is covered with phreatophytes. Black greasewood (Sarcobatus vermiculatus) is the chief phreatophyte; rubber rabbitbrush (Chrysothamnus nauseosus) is also present but in lesser amounts than the greasewood.

Greasewood generally forms a fringe to the bottomland throughout the Elko Reach, with the larger stands being found on the north side of the river between Halleck and Deeth. Major areas of rabbitbrush occur on the north side of the river, near Osino and above the Nevada Youth Training Center; small areas are found south of the river west of Elko and on the lower part of Marys Creek, west of Carlin.

Water Yield

The annual water balance studies made by the Field Party for an 80 percent frequency flow (expected to be equaled or exceeded eight out of 10 years) indicate the water yield from the Elko Reach to be negligible (computed to be 500 acre-feet) when compared to other inflow into the Humboldt River. There are some years when climatic conditions develop, however, which produce damaging floods. Calculations for the water balance assumed that (1) the several hot springs around Elko and Carlin originate outside the reach; (2) spring flow at the mouth of the South Fork of the Humboldt River is part of the discharge

from that drainage; and (3) flow from Carlin (Dwyer) Springs, west of Carlin, is either part of the return flow from the Humboldt River or part of the yield from watersheds in the Humboldt Basin other than the reach.

Records of stream flow on eight drainages in the reach also indicate negligible water yield, as no surface flow reached the Humboldt during 1953 and 1954. These years were computed to be 65 and 90 percent frequency flow years, respectively, at the Palisade gage. (See Annual Water Balance Study - 80 Percent Frequency, Appendix I.)

The principal high flow period in the river is March through June (see figure 1). Streamflow extremes are as follows:

Station	Maximum (c.f.s.)	Minimum (c.f.s.)
Ryndon	7,070 Feb. 13, 1962	No flow - many days Aug. and Sept. 1948
Carlin Canyon	6,160 Feb. 14, 1962	0.1 Aug. 16, 1957
Palisade	6,610 Feb. 12, 1962 1/	2.0 Aug. 25-58, 1931

1/ Recorded maximum. In February 1910 estimated flow was 17,000 c.f.s.

Streamflow records at the Palisade gage indicate the annual extremes range from a maximum of 636,400 acre-feet in 1952 to a minimum of 25,170 acre-feet in 1934, a ratio of more than 25 to one. The 80 percent frequency flow (expected to be equaled or exceeded eight out of 10 years) was calculated to be about 118,000 acre-feet, based on 55 years of streamflow records. The 50 percent frequency flow was 220,000 acre-feet, as differentiated from the average flow of 255,600 acre-feet.

Figure 1. -- Monthly streamflow distribution, Humboldt River at Palisade

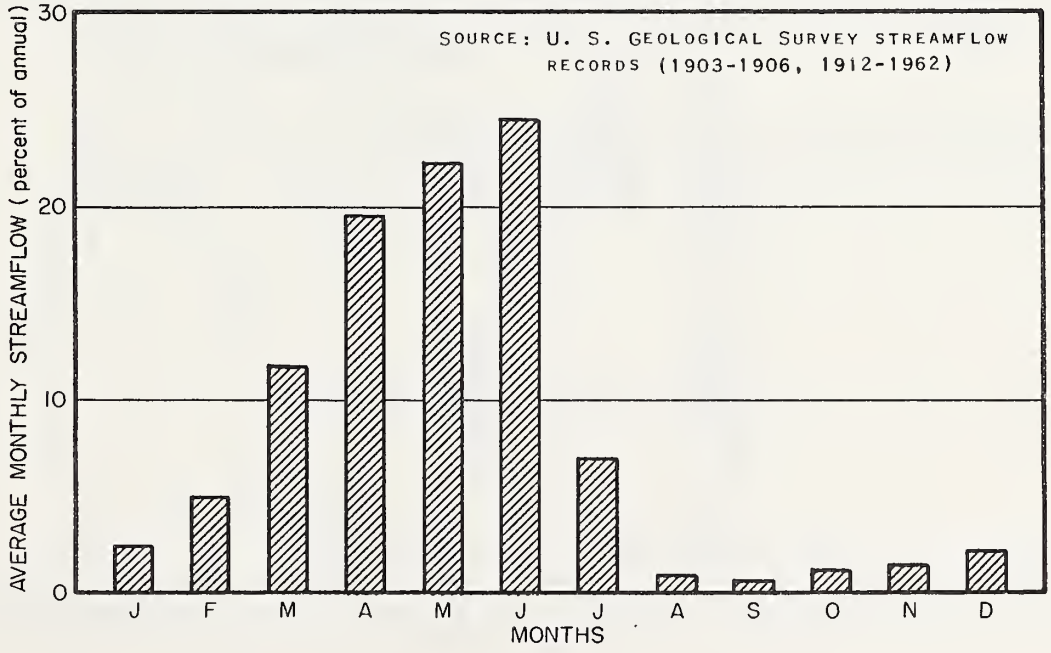
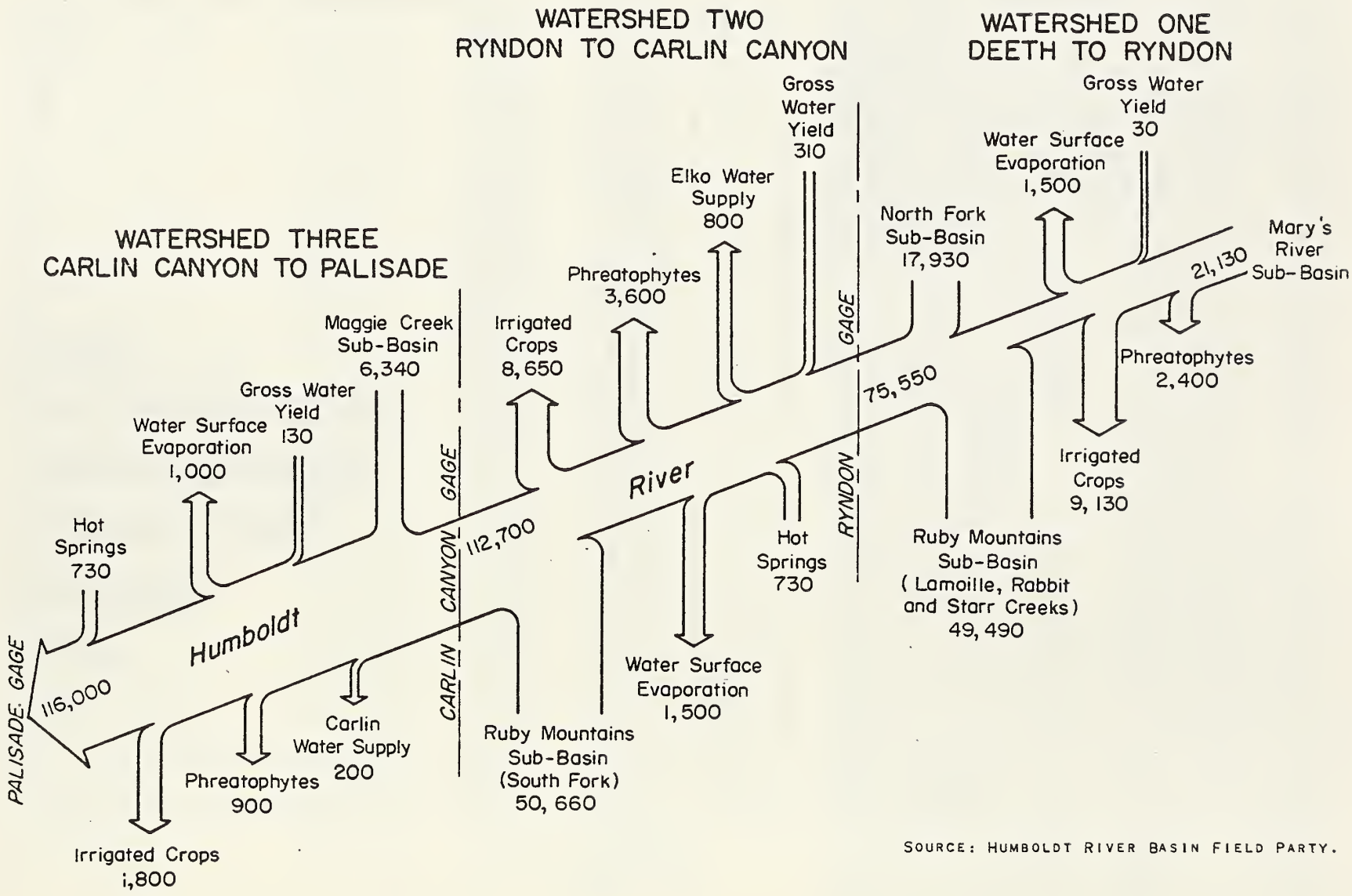


Figure 2. -- Flow diagram of water yields and depletions in acre-feet for watersheds in Elko Reach (80% frequency)



SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

A flow diagram of gross water yields and depletions for an 80 percent frequency year is illustrated in figure 2. A water balance summary from the diagram is shown below:

Water Balance Summary, 80 Percent Frequency

		Acres		Acre-feet
Gross Water Yield: Elko Reach 1/		310,000		500
Inflow:	Hot Springs	-------		1,500
	Mary's River Sub-Basin	-------		21,100
	North Fork Sub-Basin	-------		17,900
	Ruby Mountains Sub-Basin	-------		100,200
	Maggie Creek Sub-Basin	-------		6,300
	Total			147,500
Uses and Losses:	Phreatophytes	9,200 2/	(-)	6,900
	Irrigated Crops	14,200 2/	(-)	19,600
	Municipal Water	-------	(-)	1,000
	Surface Water Evaporation 3/	-------	(-)	4,000
	Total			31,500
Discharge: Humboldt River at Palisade				116,000

1/ Gross water yield, for the purpose of this study, is the estimated available water, both surface and subsurface, prior to agricultural and phreatophytic use. Generally, this water yield is estimated for a stream or streams at a point above the highest diversion for the main body of irrigated land on a flood plain of a valley.

2/ Estimated irrigated acreage during an 80 percent frequency year, and land covered with phreatophytes. These areas cannot be compared to total acreage with water rights.

3/ Loss of water by direct evaporation from surface water during periods of high flow. This loss would be in addition to the evaporation associated with consumptive use by plants.

LAND AND WATER USE

Land Status

There are 78 land owners in this reach of the Humboldt River, not including lands within boundaries of municipalities or other small tract sub-divisions. This ownership record has been compiled from data of the Bureau of Land Management at Elko and the Soil Conservation Service Work Unit offices at Elko and Wells. Sections of Federal

and private (formerly railroad) lands are intermingled in a checkerboard pattern throughout the reach. Included in the private land are an estimated 16,800 acres owned by the Southern Pacific Railroad, and 4,900 acres occupied by municipalities (Elko and Carlin).

The approximate land status breakdown is as shown below:

Land Status	Square miles	Acres	Percent of total
National Land Reserve	206.6	132,200	42.7
Elko Indian Colony	.2	200	----
County and State	2.2	1,380	.4
Private	275.4	176,220	56.9
Total	484.4	310,000	100.0

Land Use

National land reserve lands are used primarily for spring-fall and summer range for domestic livestock. Portions of these lands also serve as winter range for big game and as a year-long habitat for other wildlife. The long-range land program of the Bureau of Land Management includes encouragement of land exchanges, in order to establish a more desirable land pattern, particularly on higher watershed lands. Recreation is expected to be an important phase of the Bureau of Land Management program. The Bureau's proposed recreation development program is briefly discussed in the recreation and wildlife section.

Private lands are used for the production of irrigated hay and pasture, recreation, and for range forage. In many instances owners of unfenced private intermingled lands are granted licenses based upon the percentage of their private lands with relation to the Federal lands they control. These areas are then administered with public lands by the Bureau of Land Management. The bulk of current grazing on national land reserve range is on individual and small group allotments.

The acreage of land irrigated and the acreage of cropland harvested vary widely from year to year depending on precipitation and stream flow. Practically all irrigated land is used to produce winter feed for livestock, either as hay, pasture, or crop aftermath.

Water Rights

Determination of water rights was established by the Edwards Decree of 1935 and subsequent permits from the State Engineer's office. In general, the decree provides for a flow of 1.23 c.f.s. per 100 acres of decreed land, or at proportional rates for a specified period of time. The duty of water is represented in the following table, showing the approximate acre-feet of decreed water and acres of decreed land in the reach. Because of the intermingled use of water between the Humboldt River and side streams, there is some duplication of water rights in this table with those listed in other sub-basin reports.

Class of land		Dates of use	Approximate Number of days	Decreed water (acre-feet)	Decreed land (acres)
Harvest crop	(A)	4/15-8/15	120	45,000 1/	15,000 2/
Meadow pasture	(B)	4/15-6/15	60	1,200	800
Diversified pasture	(C)	4/15-6/15	30	4,500	6,000
Total				50,700	21,800

1/ Includes approximately 1,500 acre-feet under permit.
2/ Includes approximately 500 acres under permit.

Water Use

Annual water balance studies made by the Field Party show that during an 80 percent frequency flow year the approximate gross water yield is used as follows:

	Acres	Water use acre-feet
Irrigated crops	14,200	19,600
Phreatophytes	9,200	6,900
Surface water evaporation	------	4,000
Municipal water	------	1,000
Discharge: Humboldt River at Palisade	------	116,000
Total		147,500

The 14,200 acres of land irrigated is an estimation of the land used to produce hay and pasture during an 80 percent frequency year. This acreage varies from year to year, being primarily controlled by the quantity of water available and priority of water use, and could, therefore, differ considerably from the total acres of decreed land with water rights.

Surface Water

The dominant use of water is for irrigation. Culinary and stock water use, while of strategic importance with respect to location, quality, and availability, do not require very large quantities. There are a number of ponds and seeps used for stockwater.

Hay lands and phreatophyte areas are located principally along the valley bottoms. Most of the native hay and pasture land is irrigated continuously during the period of high seasonal stream flow. A small acreage above the flood plain of the river has been improved and receives water at intervals from springs or water wells, which furnish an adequate supply.

While use of water for irrigation and other downstream needs is highly important, the on-site requirements are also significant. Trees, shrubs, and grass require water to remain vigorous and keep the watershed in a strong hydrologic condition. Downstream

values are dependent on a healthy watershed to prevent damages from floods, sediment and debris. Water used to satisfy on-site requirements, not shown in the water use table, is that quantity which is retained in the soil. In this area, during an 80 percent frequency year the amount of water retained by the soil is almost equal to the annual precipitation. In addition, water is needed in streams for fish, aesthetic values, recreation activities, livestock, and game animals. Other on-site uses of water in the sub-basin are minor.

Ground Water

Most of the irrigated crops draw supplemental water from ground storage. There are four irrigation water wells in the reach which are used to water approximately 100 acres of alfalfa-grass.

Other ground water use is by phreatophytic plants, for municipal water for Elko, and for several low-capacity stockwater and farmstead wells. Carlin obtains its water supply from springs west of town.

Irrigation Methods

Irrigation is principally by uncontrolled wild flooding. There is only a limited amount of improved irrigation development in the area. These developments consist of land leveling, land smoothing, diversion structures, spreader ditches, and irrigation wells. Of the other methods, limited use has been made of border irrigation on improved land above the flood plain (see photographs 6 and 7).

Photograph 6. - Border irrigation on improved lands above the Humboldt flood plain, near Carlin, Nevada (start of first crop after leveling). Looking southeast toward Buckskin Mountain and the Pinyon Range. S.C.S. PHOTO 6-479-10

Photograph 7. - Mixed oats and alfalfa under border irrigation on haylands which have been leveled. Humboldt River bottomlands, eight miles east of Elko, looking north toward the Adobe Range. S.C.S. PHOTO 6-538-11

Water supplies from surface streams vary widely throughout the irrigation season, which makes the regulation of water difficult. During the high runoff period streamflow is either diverted or spreads out over meadow and pasture lands naturally; ditches are used to spread water over the land. Water is generally kept on the fields much longer than is needed to saturate the soil; this results in low irrigation efficiency, loss of fertility, and lower yields (see photograph 8).

Photograph 8. - Typical semi-controlled wild spring flooding of hay meadows along the Humboldt River, 10 miles east of Elko, looking southwest. With flood control, the establishment of improved irrigation systems, plus leveling and the growing of higher-yielding forage crops, production could be at least doubled. S.C.S. PHOTO 6-46-3

THE AGRICULTURAL INDUSTRY

Ranch Operation

Within the Elko Reach are 22 range livestock ranches; of that number, 13 are headquartered in the reach; not all these ranch holdings lie within its boundaries. All 22 livestock ranches in the reach are commercial-type ranches deriving the major portion of their income from production of livestock and livestock products. Livestock have always been the major agricultural export from the reach. About 98 percent of all agricultural products sold come from this source; the remaining two percent is derived from the sale of crops.

Most ranches in the Elko Reach are owner-operated. In Elko County, since 1929 ranchers owning all the private land they operate have averaged 75 percent. From 1949 to 1959, the percent of full owners decreased from 81 to 71 per cent, according to the Census of Agriculture, because of an increase in numbers of managers and part-owner-operators. All ranchers in the reach hold licenses to graze livestock on Federal land.

Hay provides 25 to 30 percent of the feed requirement for livestock in the reach. Grazing on crop aftermath, adjacent dry and irrigated pasture furnishes from 15 to 20 percent, and the remaining 50 to 60 percent of the feed requirement is harvested from Federal and intermingled private spring-summer-fall rangeland in the area.

More A.U.M.'s of winter feed, in the form of hay and aftermath grazing, are generally harvested on irrigated lands than are harvested by grazing on the spring-summer-fall public and private rangeland. Because of the imbalance of winter feed to summer feed, most of the cattle wintered in the reach are ranged on land outside for part of their teed requirements.

Number of Ranches

Number of ranches in Elko County decreased from a high of 595 in 1934 to 238 in 1959 (see figure 3, Appendix I). This was brought about through the consolidation of several small ranches into a few large operating units. Average size of ranch increased during this same period. The number of ranches in the reach followed a similar trend until the latter part of the fifties. At that time ranch numbers increased because parcels of land were sold from existing holdings to ranches outside the reach (see table 9, Appendix 1).

Trend in Size of Ranches

Average ranch size in Elko County has been on the increase since 1934. In 1959, the average size was in excess of 13,000 acres (see figure 4, Appendix I). Of the total ranches, 77 percent had 1,000 acres or more. The 22 livestock ranches with holdings in the reach range in size from 1,500 acres to 70,000 acres. Size of ranch in the reach decreased in the past five years because units of land were sold to ranchers who had no holdings there. This had no effect on the size of ranch in Elko County. (See table9, Appendix I.)

Photograph 9. - Improved native meadow hay, Humboldt bottomlands one mile southwest of Carlin, Nevada, looking east. S.C.S. PHOTO 6-723-2

Smaller ranches average 375 animal units while the larger size averages 4,000. In 1959, 67 percent of the commercial ranches in Elko County had sales of agricultural products in excess of $20,000 per ranch; average ranch gross sales were $55,300. In 1949, 35 percent of the commercial ranches had gross agricultural sales in excess of $20,000, and in 1939 only seven percent had sales this large. The increase was due principally to two factors: (1) a decrease in number of commercial ranches because of change in census definition of commercial farms; (2) increased livestock prices. (See table9 , Appendix 1.)

According to the Census of Agriculture, average 1959 investment in land and buildings per ranch in Elko County was $296,483; in 1949 the average investment was $53,486. For the decade, this represents more than a 550 percent increase in investment in land and buildings; this is largely attributed to an increase in ranch size. When calculated on the basis of average investment of land and buildings per acre, the increase from 1949 to 1959 was only 77 percent; this was mainly because of an increase in ranch sale prices.

Some of the holdings in the reach are family-type ranches, ranging in size from about 300 to 2,000 acres of deeded land. The majority if not all of the labor required for the ranch operation is furnished by the operator and his family.

Some of the large ranches are run by families, but in contrast to the smaller family-type ranch, these ranches hire from five to 15 employees to provide sufficient labor for operation and maintenance of the ranch. Some laborers are hired on an annual basis, while others are seasonally employed. The larger ranches range in size from about 2,000 to 50,000 acres.

Crop Production

Of the 310,000 total acres in the reach, 14,200 are irrigated cropland (80 percent frequency year), of which approximately 900 acres are in alfalfa. Alfalfa yields vary from 1.5 to 4.5 tons per acre, depending on water, weather, and management; the average is about 3.5 tons per acre, for a total of 3,150 tons. About 2,500 acres are in the production of improved meadow hay. This hay mixture yields from 1.25 to 3.5 tons per acre, averaging about two tons (see photograph 9). This amounts to a total yield of 5,000

tons. The remaining 10,800 acres of irrigated cropland produce native grass which is generally cut for hay. When there is insufficient irrigation water or a poor growing season the hay land may be pastured; these native meadows produce from .5 to 1.5 tons per acre, with an average of about one ton per acre. This represents a total yield of about 10,800 tons of hay. The total yield on 14,200 acres of cropland in the reach is about 18,950 tons of hay, and approximately 14,200 A.U.M.'s of aftermath grazing.

In 1940 most of the hay in the reach was harvested with horse-drawn machinery. Mechanization increased sharply in the early 1950's; in 1963 about 97 percent was harvested with tractor-drawn equipment. However, horses are still employed in some areas with high water table.

Livestock Production

Industries

The sheep industry in the area has been decreasing in importance. In 1959 there were approximately 90,900 sheep in Elko County, compared to 283,800 in 1929. Some sheep ranches in the area integrated their operations with a cattle enterprise, thus making them more diversified; this tended to stabilize their income. Others completely liquidated their sheep enterprise and replaced it with cattle. At present there are no ranches in the reach deriving their income entirely from the sale of sheep and sheep products.

Trends in the cattle industry have been much more stable. Cattle numbers have remained quite constant, except for changes brought about mainly by prolonged drought, varying rates of forage production, and the shifting of operations from sheep production to cattle production. (See table 9, Appendix I.)

Production

The calf crop in the reach varies widely, with yields ranging from 55 to 95 percent; the average is about 77 percent. There does not seem to be a correlation between size of enterprise and percent calf crop.

Weaning weight of calves in the reach varies from 300 to 450 pounds, and averages about 375 pounds, depending upon date of birth, available forage, and hereditary growth potential.

The lamb crop in the area ranges from 80 to 120 percent, and averages 100 percent. A large percent of lambs has sufficient finish to go directly to packers, while the remainder are fed out in feed lots outside the State.

Livestock Numbers

Cattle numbers on ranches in the reach have been increasing since 1959, but sheep numbers have steadily decreased since 1954. The reach is primarily a winter feeding area for cattle grazed on the surrounding ranges.

Livestock Marketing

Market data are not available for the Elko Reach itself, but county figures represent marketing practices and characteristics that exist in the reach. Major classes of cattle shipped from Elko County in 1959 were: Steers, 32.8 percent; heifers, 20.7 percent; cows, 20.0 percent; and calves, 16.6 percent. The trend in recent years has been toward shipping more weaner calves and fewer yearlings. The majority of calves are contracted for sale prior to weaning or are sold at the ranch after weaning. Cull cows and bulls are often sold at the Elko auction. (See Agricultural Industry, Appendix I.)

California received 31.6 percent of the cattle shipped from Elko County in 1959. Idaho feeders and packers bought 25.8 percent, and 24.4 percent remained in Nevada, but were shipped to other counties. The remaining 18.2 percent were shipped to other western States.

California market demands for all in-shipments of cattle over a 20-year period (1940 to 1959) have grown at 3.75 percent per year, but Nevada shipments to California over the same period have increased only 2.34 percent per year for all classes. If post-war years (1947 to 1959) are used, there has been only a slight increase in number shipped for the combined slaughter and feeder-stocker purposes. Numbers of cattle shipped to California for immediate slaughter have been on the decrease, mainly through changes in grade demanded by California packers.

Transportation

Trucks transported 69.2 percent of cattle moved from Elko County in 1959; another 28.8 percent moved by rail, and 2.0 percent were unknown. Of cattle shipped to California, 90.6 percent moved by truck; only about 20 percent of the cattle shipped to Nebraska traveled in this manner.

Transportation facilities available to Elko Reach ranches are adequate. Two interstate railroads, Southern Pacific and Western Pacific, serve the area and provide daily schedules to the west coast and to Ogden, Salt Lake City and points east. Both railroads offer livestock transportation service, with loading facilities at Wells, Deeth, Halleck, Elko, Carlin, and Palisade.

Several common motor freight carriers maintain terminals in Elko, and provide pickup and delivery service within the reach, with interstate service to all parts of the nation. Local truck carriers, as well as a number of truck carriers from California and other western States, provide livestock transportation service.

Two transcontinental bus lines provide daily passenger service for Carlin and Elko. One commercial airline serves the City of Elko daily; in addition, there are several charter air services available at that point.

Transcontinental U. S. Highway 40 (Interstate 80) at Elko, Wells, and Carlin links the area with all eastern and western points. U. S. Highways 43 and 11 link U. S. 40

with points in Southern Idaho and Oregon. Numerous other roads and truck trails provide access to most pasts of the area, at least during good weather.

WATER-RELATED PROBLEMS IN THE REACH

Agricultural Water Management

Seasonal Distribution of Water

Most of the irrigated hay and pasture land is flooded continuously during the period of high seasonal stream flow. Runoff usually occurs from March through June. The flooding is caused by both poor channel conditions and obstructions (tight dams) in the river channel. Generally, these conditions result in the production of low-yield forage plants which will tolerate wide extremes in soil moisture over extensive periods of time. Of the total acreage of the irrigated land less than one-tenth has been improved. This improved land is adequately irrigated from springs or wells.

Soils

Principal soils problems on irrigated land are high water table, poor drainage, lack of fertility, overflow, and salt and alkali concentrations. These problems usually occur in the Humic Gley Soils found in the flood plain of the river. (See soils tables 6 and 7, Appendix I.)

Thinning of vegetal cover on the range areas, particularly on the intermediate mountain slope and upland bench and terrace sites, has led to considerable topsoil loss through sheet erosion. This has resulted in gravel-paved surfaces, and loss of humus and soil fertility.

Control of Water

Obstructions in the river channel divert stream flow over hay lands or into irrigation ditches during the runoff period. It is difficult to regulate irrigation water needs with these uncontrolled diversions (see photograph 10). In most fields, additional ditches, gates, and other control structures are needed for better water distribution.

Irrigation Efficiency

For almost a century croplands in the bottomland along the Humboldt River and many of its tributaries have been irrigated by natural and artificial flooding. In the future, the ever increasing demand for water may stimulate a change in its use. At that time present procedures may not be the most economical or practical method of applying water to cropland.

At the present time, on-the-farm irrigation efficiency (amount of water required to bring the soil in the root zone to field capacity divided by the amount of water applied) is quite low; it is estimated to be 20 percent or less on most fields. This is in contrast to

Photograph 10. - Uncontrolled diversion (tight dam) on the Humboldt River at Ryndon, approximately 10 miles east of Elko, looking westerly.

FIELD PARTY PHOTO 6-773-2

efficiencies of 50 percent or more which can be expected from irrigation on croplands that have been improved. Excess water applied to fields is not necessarily lost; it may either return to stream flow or supplement ground water storage.

Any improvement in irrigation water management, such as controlled diversions, land smoothing, spreader ditches, etc. will help to increase irrigation efficiency and reduce management problems. More intensive improvements for greater efficiency must be preceded by installation of flood control structures to protect land treatment measures, or to permit the relocation of the croplands to selected areas above the flood plain.

Drainage

Salt and alkali concentrations, and year-long or seasonal high water table in some areas, limit the types and yields of crops that can be grown. Some of the trouble spots are caused by over-irrigation of lands, and others by returning ground water.

Flood Damage

The Elko Reach has been subjected to many periods of flooding or high water. Both flood types - wet-mantle and dry-mantle - have been destructive, in terms of recorded flood, erosion, and sediment damage. The dry-mantle type, the damage from which in most areas is usually localized at the stream sources on the higher watersheds, through the years has caused extensive property damage on the lower reaches of the Adobe Range drainages.

The wet-mantle flood years of 1870, 1881, 1884 and 1890 (the "White Winter"), inflicted erosion damage, property damage and destruction, and livestock losses all along the reach. For more detailed account of these floods, see the Field Party Chronology of Flood Years and High Water Years.

Wet-Mantle Floods

February 18 - March 15, 1910. - A system-wide flooding of the Humboldt. The flood was brought on by extended periods of warm rains on heavy snow or frozen ground, particularly during the peak period, February 27 - March 5.

Southern Pacific and Western Pacific grades and bridges were damaged from Montello and Wells to Elko. Deeth was flooded by the ice jams in Mary's River; homes, warehouses, and other buildings were inundated, inflicting several thousand dollars damage.

The Western Pacific lost a small bridge at Halleck, and the Humboldt flowed over the W. P. tracks at Ryndon. The ice jams at Osino and through Elko on the Humboldt caused flooding of railroad installations, homes and business establishments in the vicinity of the river.

In addition to flooding from the river, Elko suffered at the same time by overland flows from the Adobe Range. Homes and businesses along Court, Idaho, Railroad and Commercial Streets were hit by these northern floodwaters. The Lytton (Ninth Street) iron bridge, built after the 1884 flood, was only saved by removing all railings, floor planking, and stringers; its abutments were washed out, and the bridge was knocked out of alignment. The Hot Hole iron bridge at Elko's west end was badly weakened.

Carlin and Palisade were flooded. In Palisade, all the town south of the Southern Pacific tracks was washed away. The debris lodged in a heap against the Southern Pacific bridge below the town, but the bridge held. Five feet of water flowed through the Eureka & Palisade roundhouse and shops, and the E. & P. trestle and the county bridge on the Pine Valley road were both washed away.

The Southern Pacific grade between Carlin and Palisade was badly washed; one bridge was destroyed. Through passenger and freight traffic on the Southern Pacific was completely stalled for 10 days by the washouts between Carlin and Battle Mountain. During at least part of this period, as many as seven passenger trains were stranded in the S. P. yards at Palisade.

The newly constructed Western Pacific line between Carlin and Winnemucca suffered terrific damage. Besides extensive washouts in Palisade Canyon, a seven mile stretch of roadbed west of Beowawe was practically washed away, and at least 19 Western Pacific bridges between Carlin and Winnemucca were weakened or destroyed.

1914, 1917, 1921. - The wet-mantle floods for these years also inflicted damage varying from minor to major proportions along the reach. A more detailed account of these flood years may be found in the Chronology of Flood Years and High Water Years.

April 3 - May 1, 1942. - Heaviest flood on the upper and middle Humboldt since 1910, triggered by warm rains accompanied by warm winds on April 3-4. This resulted in the melting of unusually deep snow accumulations on the lower slopes.

The flood peak occurred April 3-7 at Elko; residential areas there were flooded. Fifteen families were evacuated. As a result of this flood, the City of Elko later that year built its first levee along the Humboldt, south of the river.

Some livestock losses occurred all along the Humboldt because of miring, drowning, or starvation. A landslide in Palisade Canyon above Palisade caused the Humboldt to flood both the Western Pacific and Southern Pacific grades; considerable delay to train movements resulted.

January 21 - 27, 1943. - This flood was brought on by a terrific driving rain storm which lashed all of Nevada and eastern California on January 20-21, melting the winter snow accumulations. The floods of 1943 produced higher crests through the Elko Reach than those of 1942. At Elko, in spite of the levees erected in 1942, the lower portions of the town were again flooded, particularly on the north side of the river. As a result, the levee system was enlarged and lengthened.

February - May 1952. - A system-wide flooding of the Humboldt which resulted from the melting masses of snow accumulated during the winter of 1951-52. This winter was often contrasted with the 1889-90 "Winter of White Death". Thanks to the levee system of Elko, there was no flooding, although the Humboldt bottomlands all along the reach were flooded extensively. No records of flooding at Deeth, Carlin, or Palisade have been found.

February 9-13, 1962. - Six days of intermittent snow, rain, and some hail in the middle and upper Humboldt Basin effectively broke the three-year 1959-61 drouth. It also produced flood crests on the upper Humboldt equalling or possibly exceeding those of 1910. Damage or destruction of highway, railroad, structural and other streamside installations occurred throughout the reach (see photographs 11 and 12).

Elko, because of its levee system, received little damage. Portions of the railroad yards and the lower residential areas at Carlin were flooded. Some miring and drowning of livestock also occurred throughout the reach, although most of the cattle feeding along the Humboldt bottoms were evacuated to higher ground before the flood crests hit.

For a more detailed account of this 1962 wet-mantle flood, the reader is referred to the Field Party's special Humboldt Basin report, Chronology of Flood Years and High Water Years.

Photograph 11. - Road washout, McKinley Ranch, February 1962, 8 miles west of Elko, looking south.
S.C.S. PHOTO 6-656-10

Photograph 12. - Looking south near Osino, Nevada across the flooded Humboldt River bottomlands toward Up River Peak (Elko Mountain), February 13, 1962.
S.C.S. PHOTO 6-659-10

Dry-Mantle Floods

July 25, 1874. - This is perhaps the earliest record of the classic pattern of summer rainstorm flooding along the Humboldt, resulting in localized but severe flood damages. A dry-mantle flood from the slopes of the Adobe Range in the vicinity of Osino washed out the Central Pacific main line. Overland trains both east and west were delayed several hours.

July 23, 1876. - Another washout at Osino damaged C. P. Trackage. Eastbound trains were held overnight at Elko, and westbound at Osino.

August 12 - 16, 1941. - A flash flood down Emigrant Canyon and across U.S. 40, immediately west of Primeaux Station on Emigrant Pass, caught two autos containing six people. One man was drowned; the cars were swept over a mile down the canyon.

August 6 - 28, 1961. - On August 6, a heavy afternoon thunderstorm accompanied by strong winds over much of the Humboldt Basin resulted in widespread damage. Idaho Street in Elko was flooded; basements of hotels and businesses along this street and along the Western Pacific between Second and Fifth Streets were flooded (see photograph 24). Damage occurred at the Elko Golf Course and Fair Grounds.

Southern Pacific track was weakened by small washouts near the Nevada Youth Training Center, east of Elko. Approximately $1,500 erosion damage was sustained by croplands and installations at the Training Center. U.S. 40 was damaged by sediment in this same vicinity. Three days (August 6-8) were required for highway cleanup and repair.

On the night of August 12-13, another storm closed U.S. 40 from washins in Carlin Canyon; a six to eight hour delay resulted to highway travel there.

Vegetal Conditions

Range and Watershed

Watershed conditions in the reach generally are detoriated, particularly those areas immediately adjacent to the fenced Humboldt River bottomlands. Range forage conditions in these fringe fenced areas and in isolated areas distant from water or not accessible to livestock are in the medium or fairly high forage production classes. Range forage for the rest of the Elko Reach has deteriorated to the low forage production class.

Table 1 indicates the acreage by classes of present annual forage production, grouped by soils for each vegetal type and site. The rates in this table are indicative of the total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. Carrying capacity for any particular range depends on such factors as slope, soil depth, soil character and stability, and the management objectives of the owners or administrative agencies.

Heavy use of the rangelands - first by livestock of the emigrants which passed through beginning in 1841, and later by the ranching industry starting in 1870 and continuing up to the present time - has seriously depleted the better forage species. Nevada

bluegrass (Poa nevadensis), bluebunch wheatgrass (Agropyron spicatum), needle-and-thread (Stipa comata), and Indian ricegrass (Oryzopsis hymenoides), where still present, are greatly diminished from their pristine occurrence, density, and vigor. With the loss of these bunch grasses, some topsoil has been removed by sheet erosion, and a greater amount by slight to severe gully erosion. All streams and drainageways of the reach show some form of accelerated erosion and sedimentation.

Table 1. -- Acreage of present annual forage plant production classes, grouped by soil associations for each vegetal type and site, Elko Reach

Vegetal type and site	Acreage of forage plant production classes		
1. Rabbitbrush-greasewood-grass; saline bottomland	Production classes (pounds per acre) 1/		
	850-1,500	200-900	20-300
Soil associations	(acres)	(acres)	(acres)
B4-R10-L4	-----	-----	300
H1-H4	-----	-----	18,600
H2-A2	-----	-----	1,000
H6-H5	-----	-----	5,300
S4-Y2	-----	-----	900
Subtotal	-----	-----	26,100
2. Meadow grasses-forbs-sedges; semi-wet meadow	Production classes (pounds per acre) 1/		
	1,200-3,000	600-2,000	200-1,000
Soil associations	(acres)	(acres)	(acres)
H1-H4	-----	2,900	1,400
H2-A2	-----	100	-----
H6-H5	-----	4,000	-----
Subtotal	-----	7,000	1,400
3. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/		
	250-600	100-450	20-250
Soil associations	(acres)	(acres)	(acres)
B1-L1-B4-C4	-----	-----	9,200
B1-R1-L4	-----	1,600	7,700
B4-R10-L4	-----	-----	28,900
B4-R10-S8	-----	-----	12,700
S3-S10-L6	-----	12,600	9,700
S4-S10-Y2 (50-40-10)	-----	-----	41,500
S4-S10-Y2 (60-20-20)	-----	-----	11,600
S4-Y2	-----	4,000	24,900
S11-B2-Y2	-----	-----	11,300
Subtotal	-----	18,200	157,500

Continued

Table 1. -- Acreage of present annual forage plant production classes, grouped by soil associations for each vegetal type and site, Elko Reach -- Continued

Vegetal type and site	Acreage of forage plant production classes		
4. Low sagebrush-grass; claypan bench	Production classes (pounds per acre) 1/		
Soil associations	200-500 (acres)	100-250 (acres)	50-150 (acres)
B1-L1-B4-C4	1,300	400	-----
B4-R10-L4	-----	-----	2,300
C4-B10-L1	-----	-----	6,000
S11-B2-Y2	-----	4,900	400
Subtotal	1,300	5,300	8,700
5. Pinyon-juniper-grass; shallow stony slopes	Production classes (pounds per acre) 1/		
Soil associations	100-250 (acres)	50-150 (acres)	10-75 (acres)
B1-R1-L4	-----	-----	1,300
B4-R10-L4	-----	10,800	11,200
C4-B10-L11	-----	-----	500
Subtotal	-----	10,800	13,000
6. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/		
Soil associations	300-650 (acres)	150-350 (acres)	50-200 (acres)
B1-L1-B4-C4	2,000	4,600	600
B4-R10-L4	-----	2,200	-----
C4-B10-L11	-----	-----	37,100
Subtotal	2,000	6,800	37,700
Total	3,300	41,100	251,400

1/ These figures indicate total annual forage production (dry weight), and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

The rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher.

Source: Humboldt River Basin Field Party.

Photograph 13. - Great Basin wildrye pasture near Carlin, Nevada, looking southeast toward Grindstone Mountain. By deferment from grazing use until midsummer, this pasture has been restored to near its pristine vegetal cover. Before treatment, the principal species present was rubber rabbitbrush, with a thin grass-weed understory. Now, in addition to a thrifty stand of giant wildrye, other perennial grasses, including alkali bluegrass, alkali sacaton, and creeping wildrye are found. S.C.S. PHOTO 8-382-6

Fringe fenced areas of rangeland, adjacent to the meadow cropland, consisting of such important forage plants as Great Basin wildrye (Elymus cinereus), creeping wildrye (Elymus triticoides), Nevada bluegrass (Poa nevadensis), reed canary grass (Phalaris arundinacea), and Kentucky bluegrass (Poa pratensis) are generally in the fairly high forage production class. These areas show little or no active erosion. (See photograph 13.)

Overuse of the range resource by domestic livestock and by big game animals has adversely affected a major portion of the watershed cover. Most of the terraces, benches and intermediate mountain slopes were once sagebrush-grass ranges. Relict areas on Marys and Grindstone Mountains and north of the airway beacon at Carlin Canyon give an indication of the former forage production. Bluebunch wheatgrass, Great Basin wildrye, needle-and-thread grass, Thurber's needlegrass (Stipa thurberiana), and Nevada bluegrass once constituted the major livestock forage species in the basin. Sagebrush was present, but in much lesser amounts.

An editorial from the Elko Daily Free Press of March 16, 1870 had this to say about the rangeland around Elko:

> "In the summer season we have rich bunchgrass, covering every hillside with a luxuriant growth, and in winter, foothills and valleys are covered with the rich white sage, that cannot be surpassed by any of nature's nourishing product for the fattening of cattle".

Today, the chief livestock forage plants are Sandberg bluegrass (Poa secunda), bottlebrush squirreltail (Sitanion hystrix), and cheatgrass (see photograph 14). Table 1 indicates one percent of the present vegetal cover is in the fairly high forage production class, 17 percent in the medium, and 82 percent in the low. Nearly all of the range in the high forage production class is relatively unused by livestock because of terrain or lack of water.

Photograph 14. - Big sagebrush-grass range in medium forage production class, upper Waiter Creek, northeast of Deeth, Nevada, looking southwest. Principal species present in the understory are Sandberg bluegrass, Great Basin wildrye, squirreltail, cheatgrass, and a scattering of annual and perennial forbs. Ground cover density is rather low. FIELD PARTY PHOTO 6-771-10

Photograph 15. - Deeply gullied Marys Creek bottomland, northwest of Carlin, looking upstream. The gully, still very active, occupies most of the accessible range area, and has desiccated the little portion still left. FIELD PARTY PHOTO 6-771-1

The bottomland along Marys Creek is extensively gullied and has very little value for livestock forage, particularly in the upper reaches.(see photograph 15). Tonka, Four Mile, Eight Mile, Kittridge, and Jackstone Creeks have moderate to severe gully erosion in some parts of their drainageways (erosion classes 1 and 2). Creeks which have slight amounts of erosion are Adobe, Sherman, White Rock, and Slaughter House.

The bottom range lands along the Humboldt River consist of such native grasses as Great Basin wildrye, saltgrass (Distichlis stricta), creeping wildrye, Nevada bluegrass, and tufted hairgrass (Deschampsia caespitosa). Generally, this range is in the medium to fairly high forage producing classes, except from the east entrance of Carlin Canyon to Palisade. Here the bottomlands have been used very heavily for a long period of time and much of the willows that protected the river banks from undercutting and eroding have disappeared (see photograph 16). This section of the river channel falls in erosion class 2 and 3; many acres of valuable hay land, as well as fringe areas of rangeland, have been completely washed away. Other areas have received considerable amounts of siltation and deposition.

Small acreages of crested wheatgrass seedings have been tried at various locations in the reach. To date, for various reasons, these seedings have not been completely successful and do not rate above the medium forage production class. Re-establishment of big sagebrush and competition by cheatgrass have kept the seedings from becoming more productive.

Photograph 16. - Humboldt River bottomland and stream banks laid bare through extremely heavy livestock use, east entrance to Carlin Canyon, looking southward toward Grindstone Mountain. S.C.S. PHOTO 6-458-5

Phreatophytes

The phreatophytes of low economic value consist largely of greasewood and rubber rabbitbrush. Plant composition of these phreatophyte areas consists of nearly pure stands of each to an admixture of both (see photograph 17). From the nearly pure stands to the admixture, percentage composition of all vegetal species varies widely. Other low economic value phreatophytes are rose (Rosa spp.) and willow (Salix spp.). Location of the major areas of phreatophytes is given under General Cover Conditions.

Photograph 17. - Rubber rabbitbrush phreatophyte area with a scattered admixture of greasewood. The understory consists of scattered Great Basin wildrye, squirreltail, cheatgrass, perennial and annual forbs. Humboldt River bottomland southwest of Carlin, looking northeast toward Maggie Creek and Swales Mountain. S.C.S. PHOTO 6-762-11

Photograph 18. - Big sagebrush-grass cover destroyed by man-caused fire, U.S. Highway 40 west of Elko, summer of 1957. With this destruction of the original plant cover, the vegetal types coming in, such as cheatgrass and annual weeds, heighten the fire danger by providing flash fuels. The risk of accelerated erosion from loss of plant cover is self-evident. S.C.S. PHOTO 6-382-9

Plant understory to the greasewood is sparse on the more saline and alkali sites, with moderately heavy stands of saltgrass, wiregrass (Juncus spp.), alkali sacaton (Sporobolus airoides), and sedge (Carex spp.) on the more favorable soils. Mixed with the grasses and sedges are such annual forbs as tumble mustard (Sisymbrium altissimum), tarweed (Madia spp.), pepperweed (Lepidium fremonti), thickstem wildcabbage (Caulanthus spp.), princesplume (Stanleya spp.), and thelypody (Thelypodium spp.). Throughout all the phreatophytic stands, Great Basin wildrye is found in varying amounts.

Along the river are also found stands and stringers of willows encroaching upon the native meadow pastures and haylands. Understory to the willows are such shrubs as rose, currants (Ribes spp.) and cudweed sagebrush (Artemisia gnaphalodes). Grasses found under and among the willows are thickspike wheatgrass (Agropyron dasystachyum), creeping wildrye, Great Basin wildrye, Nevada bluegrass, reed canarygrass, and Kentucky bluegrass. All forbs listed for the greasewood and rabbitbrush stands may be found with the willows. In addition, false solomonseal (Smilacina spp.) and cinquefoil (Potentilla spp.) may be present. (See photograph 5.)

Acreage occupied by the willow-grass plant community is approximately 2,800, with willows making up 30 to 50 percent of the stand. (See table 2.)

Fire Protection

Range fires in the immediate past have caused widespread watershed damage along the reach, and remain an omnipresent threat. With deterioration or destruction of the original plant cover, whether brought about by fire or other watershed abuse, the vegetal types coming in increase the fire hazard by providing flash fuels (see photograph 18). Fire on the upland slopes of either the Adobe Range or Elko Hills could be seriously damaging to the watershed areas, as well as a threat to the City of Elko and the town of Carlin.

Table 2. -- Phreatophyte acreage and annual ground water use, Elko Reach 1/

Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	Annual ground water use 2/ (acre-feet)
Willow	6-12'	.5-.6	-----	1,150	2.3	2,640
Rose	3-8'	.5-.6	-----	480	1.5	720
Black greasewood	3'+	.04-.075	-----	3,800	.3	1,140
Rubber rabbitbrush	3'+	.05-.075	-----	2,150	.4	860
Saltgrass	----	.06	-----	50	.5	20
Great Basin wildrye	----	.05-.075	-----	1,190	1.0	1,190
Creeping wildrye	----	.5-.6	-----	290	1.0	290
Alkali sacaton	----	.06	-----	90	.5	40
Subtotal				9,200		6,900
Irrigated meadow hay and pasture 3/	----	-----	1,000		.3	300
Wet meadow 3/	----	-----	13,200		.5	6,600
Subtotal			14,200			6,900
Total			14,200	9,200		13,800

1/ These values in the table, when referred to in the text, are rounded.
2/ These values are based on natural densities and 100 percent composition, for each species, except for the irrigated and wet meadows.
3/ Mixture of Great Basin wildrye, creeping wildrye, sedges, and other grasses.

Source: Humboldt River Basin Field Party.

As time goes on, risks of fires caused by the rapidly increasing recreation and hunter use of the watershed lands will continue to mount. Prevention or prompt suppression of potentially disastrous range fires is now and will continue to be an important facet of resource and watershed management.

RECREATION AND WILDLIFE

Recreation Developments

At present there are no public recreation developments on the privately owned lands of the Elko Reach, nor are any contemplated. Because of the devotion of a major portion of the Humboldt bottomlands along the reach to hay production, opportunities for recreation development on these lands are limited. There is some possibility of digging deep pits and channels below the water table in the bottomland areas. These could then be stocked with fish and developed into revenue-producing fisheries for the landowners.

Within the reach there are perhaps more points of prime significance in the history of Nevada and the American West than in any area of similar size in the Humboldt Basin. These sites are being increasingly sought out and visited by tourists and the history-minded, both from within and outside Nevada. Some locations were important during the fur trade and covered wagon periods, and some achieved significance when Elko, Carlin, and Palisade were developing as freighting and staging centers during the mining boom period of the 1870's.

Photograph 19. - Wagon ruts of the California Emigrant Trail, looking eastward toward Carlin from the trail's eastern approach to Emigrant Pass. U.S. Highway 40, out of sight on the ridge to the left, becomes distantly visible in the left background. FIELD PARTY PHOTO 6-776-12

Many of the sites, such as the emigrant road between Carlin and Emigrant Pass, are in imminent danger of destruction or obliteration, and will soon be lost to posterity unless rehabilitation measures are undertaken (see photograph 19). A few of the most important locations are listed here as being worthy of some type of monument, marker, roadside rest area, or restoration. They are: Ogden's fur-trapping and exploring activities in the area between Carlin and Halleck, including the grave of the trapper Paul, the first white man to die in the Humboldt Basin; the confluence of the Hastings Cutoff, route of the Donners, with the main California Emigrant Trail below Elko; the remnants of the California Trail over Emigrant Pass; the Elko-White Pine Toll Road; the Hill Beachey Toll Road; the Elko and Idaho Toll Road; points along the Elko-Tuscarora Stage Road; the Palisade townsite; and a myriad others.

National Land Reserve

There are at present no developed recreation facilities on the national land reserve in the reach. The Bureau of Land Management, in its 1959 recreation inventory report, and a 1963 updating of that report for this portion of the Humboldt, proposes the development of several picnic areas, wayside rests, and camp sites. (See table 3.)

Wildlife

Deer and Other Big Game Hunting

The bottomlands of the Elko Reach have some significance as a mule deer range. Deer from adjoining winter ranges seek feed and shelter on these bottomlands and haylands during the late winter and early spring months, but their numbers are ordinarily not large.

There is one important deer concentration area in the reach: the winter range in and around Carlin Canyon. The range here has deteriorated badly in past years from too-large winter concentrations of deer. This is evidenced by the obvious high-lining of juniper and by the extreme hedging of the current growth of bitterbrush (Purshia tridentata), and the increasing number of dead or dying bitterbrush plants. Milder winters in recent years, coupled with the reduction in wintering deer numbers, have afforded some relief to this range, however. Tagging studies indicate that these deer have spent their summers as far north as Wildhorse Reservoir and the Petan Ranch.

Access roads for hunting in the reach are generally adequate.

Fishing

At the time the Elko Reach was first settled by whites, this portion of the Humboldt River was noted for its trout fishing. The Elko Independent for June 30, 1869 noted that small boys were catching long strings of fine cut-throat trout along Maggie and Susie Creeks and stretches of the Humboldt River adjacent to Carlin.

In light of this statement, fishing conditions and fish populations have obviously worsened radically during the past 90 years. Although large cut-throat trout continued to be taken along the Humboldt through and including the first quarter of this century, the many years of wholesale and uncontrolled depredation have practically eliminated trout fishing along the river. The files of the Independent for the 1870's are replete with accounts of seining and dynamiting on the Humboldt. Tight dams and loosely controlled wild flooding irrigation methods, channel siltation and the resultant elimination of fish food sources, alternation of wet and dry years and the accompanying great variance in river flow and water temperatures have all contributed their share to the depletion of

Table 3. -- Potential developments, recreation inventory report, 1959, national land reserve, Elko Reach

Site name and type of development	Acres	Site devel. cost (dols.)	Access roads: Miles	Construction cost (dols.)	Right of way acquisition cost	Yearly maint. cost (dols.)	Trails: Miles	Devel. cost	Water devel. cost	Total devel. cost	Area affected: BLM	Area affected: Other
Jackstone picnic site	--	900	7	1,750	1,400	105	--	---	300	4,300	80	---
Blacktail Deer wayside	3 (Est.)	22,000 (Est.)	--	-----	-----	---	--	---	---	22,000 (Est.)	--	---
Cathedral Rock waysi de	4 (Est.)	20,000 (Est.)	--	-----	-----	---	--	---	---	20,000 (Est.)	--	---
Tonka Canyon camp site	--	500	5	1,250	600	75	--	---	500	2,800	40	---

Source: Bureau of Land Management, Elko District.

fish populations, and have rendered the permanent establishment of various fish species difficult. Stocking records of the Nevada Fish and Game Commission at Elko dating back to 1936 indicate that, despite the introduction of many trout species along the Humboldt main stem, establishment of a fishery of this type has not been successful.

In 1956 smallmouth bass were distributed at four locations along the Humboldt River between Moleen in Elko County and Rock Creek in Lander County. That same year, 1,800 largemouth bass were stocked three miles below Elko, and channel catfish were introduced into the river from Elko to Palisade. Again, in 1963, channel catfish were released at Halleck, Ryndon, Carlin Canyon, and Palisade. (See table 4.)

Follow-up checks by Commission technicians using seines and electrical shocker equipment gave occasional encouraging results; in 1959 many smallmouth bass, the offspring of the 1956 release, were captured at the entrance to Carlin Canyon. This, however, was the only significant indication of good natural reproduction for the species. Subsequent inventories in later years in the same area failed to reveal further propagation.

Small Game

A study of the changing plant ecology of the saline bottomlands and upland bench and terrace range sites in the Elko Reach for the past 90 years suggests the plausibility of a tie with the corollary change in upland bird species and numbers. Early emigrant journals and newspaper accounts speak of the large numbers of sharp-tail grouse, referred to as "prairie chicken" in many of the accounts. Later, with the thinning or depletion of the pristine perennial grass understory, and the thickening of the sagebrush, rabbitbrush and greasewood overstory, this grass-loving grouse species was virtually replaced by the sage grouse, which is dependent upon sagebrush for nesting cover and practically all its food (approximately 80 percent in adult birds).

Around 1900, cheatgrass began to replace the depleted climax perennial grass-forb understory, and to take over large areas of the sagebrush overstory, thinned or eliminated by range fires or overly heavy sheep use. In 1949, the Nevada Fish and Game Commission introduced the chukar partridge into this part of Nevada. This bird, which thrives on cheatgrass, has since rapidly increased in numbers. At the same time, except for some cyclic increases, sage grouse numbers have generally declined.

Valley quail, mountain quail, and Hungarian partridge are occasionally seen along the reach and its various tributaries, but are nowhere abundant. At this writing the Nevada Fish and Game Commission is trapping valley quail in western Nevada and transplanting them to the upper Humboldt Basin, in an effort to bolster the quail population and enhance the hunting opportunities for that species.

Ducks provide some hunting along the scattered ponds, channels, and sloughs of the reach during the season. Their small numbers, however, coupled with the difficulty of public access to these bottomland waterfowl habitat areas, provide little inducement to hunters. Mourning doves and cottontail provide some hunting sport along the reach every year.

Table 4. -- Fish stocking history, Elko Reach, 1936-63

Year	Species	Number or weight	Size (inches)	Location of planting
1936	Rainbow trout	10,000	3	Mouth of South Fork
1937	Rainbow trout	4,200	6	Fernald Ranch, east of Elko
1941	German brown trout	12,000	3	Carlin Canyon
1942	German brown trout	36,000	2	Carlin Canyon
1947	German brown trout	22,000	2	Carlin Canyon
1948	German brown trout	45,000	2	Carlin Canyon
1948	German brown trout	40,000	2	Carlin Canyon
1948	German brown trout	48,000	2	Moleen, above Carlin Canyon
1951	German brown trout	2,100	7	Carlin Canyon
1951	German brown trout	1,540	7	Carlin Canyon
1953	Eastern brook trout	350 lbs.	-	---
1955	German brown trout	812 lbs.	-	---
1956	Small mouth bass	839	-	Moleen, Carlin Canyon, Palisade, Rock Creek
1959	Large mouth bass	1,780	-	Roy Young Ranch, west of Elko
1959	Channel catfish	15,000	-	Young Ranch to Palisade
1963	Channel catfish	30,000	-	In the Elko vicinity (Note: a few bluegill sunfish were also planted here at this time.)

Source: Nevada State Fish and Game Department, Elko.

PROGRAMS OTHER THAN PROJECT-TYPE DEVELOPMENTS AVAILABLE FOR THE IMPROVEMENT OF WATER AND RELATED LAND RESOURCES

Lands in the reach can be treated or can receive aid for treatment under existing U.S. Department of Agriculture and other Federal and State programs. The Bureau of Land Management is responsible for range, recreation, and watershed development on the Federal lands it administers. The owners of private land can receive aid for water and related land resource development by means of various programs under the U.S. Department of Agriculture.

Technical Assistance and Cost-Sharing Under Public Law 46

Under the provisions of Public Law 46 the Soil Conservation Service furnishes technical assistance through Soil Conservation Districts, and the Agricultural Conservation Program of the Agricultural Stabilization Conservation Service provides cost-sharing. Under these programs, assistance in developing coordinated conservation plans and in applying conservation measures may be furnished for farms and ranches. These plans provide for soil surveys, land use adjustments, erosion control, water conservation, irrigation, drainage, flood prevention, and recreation development. Solution to problems of the reach on private land may be arrived at in part by these programs.

The Soil Conservation Service has the responsibility for leadership in the National Cooperative Soil Survey. With the assistance of several cooperative groups and agencies in this work, soils maps and survey reports will be published in the regular schedule of soil survey publications of the U.S. Department of Agriculture.

Agricultural Water Management

There are many ways of improving water management on individual ranches throughout the reach. Some of the treatments for various types of problems are listed below.

Problems	Suggested treatment
1. Limited water supply.	a. Develop irrigation water by drainage of seeps, springs and high water table. b. Control phreatophytic plant growth. c. Clear stream channels of all obstructions and install controllable diversions. d. Develop irrigation water wells and irrigation storage reservoirs where investigation reveals their feasibility. e. Line or seal ditches through reaches of excessive seepage loss. f. Stop applying water to fields after soil reaches field capacity.
2. Saline soils.	a. Install drains to lower water table. b. Use only good quality water for irrigation to reduce salt concentration in the soil. c. Use proper soil and water management practices.

3. High water table.	a. Install suitable drainage. b. Improve creek channels for drainage outlets, and to reduce frequent flooding of bottomland. c. Check the possibility for pump drainage. This may increase water supply for irrigation. d. Land smoothing to remove low ponding areas. e. Line and seal ditches. f. Stop applying water to fields after soil reaches field capacity.
4. Low-efficiency use of water.	a. Level or smooth land for even water application. b. Reorganize water distribution and irrigation systems. c. Line ditches through highly permeable soils. d. Stop applying water to fields after soil reaches field capacity.
5. Inadequate water distribution systems.	a. Remove "tight dams" and install controlled diversions. b. Reorganize water distribution systems. c. Use lined ditches or pipe lines through highly permeable soils. d. Construct necessary control structures in ditches (see photograph 20).

Photograph 20. - Concrete turnout, Humboldt River hay meadows east of Elko, looking southward toward Up River Peak (Elko Mountain) ridge. S.C.S. PHOTO 6-290-9

Photograph 21. - Stockwater reservoir built to improve cattle distribution and uniformity of grazing use through enhanced accessibility to previously unwatered range areas. S.C.S. PHOTO 6-699-12

Vegetal Improvement

Watershed erosion indicates the need for action to reverse the trend toward land deterioration. Each of the following solutions would contribute in some measure to the improvement of plant species and cover, which in turn will help reduce this erosion.

Problems	Suggested treatment
Irrigated lands	
1. Low yields.	a. Establish higher-yielding forage crops suitable to the soil and water conditions, for hay and pasture. b. Use irrigation methods that will permit more efficient use of water and create an environment for higher producing forage plants. c. Develop a fertilization program. d. Use feed lots when fields are wet.
Nonirrigated lands	
1. Range condition static or on decline.	a. Practice rotation-deferred grazing. b. Use bottomland pasture to supplement available range. c. Control low economic value plant growth to increase forage production. d. Develop a program of seeding the rangelands. e. Establish proper use practices. f. Fence, to enable better grazing control and proper range use. g. Improve salting and water distribution for better grazing control (see photograph 21).

Watershed Protection and Erosion Control

Intermingled private range land throughout the reach is generally in poor condition. The sparse cover in this area is conducive to active erosion (see photograph 22). Treatments required to reverse the condition trend in this area would include range seeding and spraying of sagebrush on selected sites, along with good management and proper use.

Possibilities for Water Salvage

Ground water use by phreatophytic plants was estimated to be about 13,800 acre-feet annually. This includes the water used by Great Basin wildrye and other meadow species used for hay and pasture in the valley bottoms. The acreage of alfalfa grown in the valley bottoms is comparatively small and therefore was not included.

Phreatophytic plants such as willows, greasewood, rabbitbrush, wild rose, and saltgrass, which are of low economic value, use an estimated 5,400 acre-feet of water annually. More effort should be made to control or replace these water-wasting plants by spraying, deep drainage, and blading. Most of this water could be better utilized by the control or replacement of these plants.

Bureau of Land Management Programs

National Land Reserve

The Bureau of Land Management is responsible for the administration and management of approximately 43 percent of the land in the Elko Reach. Highlights of the Bureau's range management program include the proper use and improvement of the national land reserve. In addition, the Bureau and the Nevada Division of Forestry's Northeast Elko Fire Protection District cooperate in fire presuppression and control activities on the intermingled public and private lands.

Adjudication of grazing privileges in this reach is approximately 50 percent completed. The range use is practically all in individual or small group allotments. After the allotments are fenced, management plans will be developed for each allotment to insure proper use of the forage resources.

The soil and moisture program is integrated with the grazing program and consists of stabilization and rehabilitation projects necessary to conserve soil, water, and closely related resources. The work also includes improvement of vegetation through natural revegetation, control of undesirable forage plants, the seeding of more desirable plants, as well as soil surveys and hydrological studies on pilot watershed areas. The weed control program is designed to arrest the invasion and spreading of weed species which are poisonous or mechanically injurious to domestic livestock, or which threaten the agricultural economy of the area. Another facet of range and watershed management, requiring immediate attention, is the erosion-proofing or revegetation and retirement of old, abandoned, or low-standard roads, the contributory source of a considerable amount of washing and gullying (see photograph 23). It is planned that the construction of all new roads will be done to proper standards and with adequate drainage.

Land classification, fire protection, and recreation are important phases of the Bureau of Land Management program. The long-range land program includes the encouragement of land exchanges, in order to establish a more desirable land pattern, particularly on the higher watershed lands. The Bureau's proposed recreation development program is briefly outlined in table 3.

Photograph 22. - Sparse cover on the surrounding hillsides and lack of a good perennial grass understory to the big sagebrush along the deteriorated stream bottomland are major factors contributory to the heavy channel cutting seen here. The gully, in turn, is contributing to the further deterioration of the vegetal cover by desiccation of the little bottomland remaining. Upper Marys Creek, northwest of Carlin, looking eastward (downstream). FIELD PARTY PHOTO 6-771-6

Photograph 23. - A classic example of a poorly located road along a stream bottom which has turned into a prime erosion hazard. The detour road runs where the automobile sits. Looking southeast toward Starr Valley and the East Humboldt Range, approximately five miles northwest of Deeth. FIELD PARTY PHOTO 6-771-8

Fire Protection

One Federal agency and one State agency are charged with the responsibility for fire prevention and suppression within the reach. The Elko District of the Bureau of Land Management is responsible for the protection from fire on the national land reserve. The State of Nevada, through its Clarke-McNary Northeastern Nevada Fire Protection District, protects the private lands, and assists the Bureau of Land Management with its fire suppression job.

The following factors have helped or are needed to keep abreast of the increasing fire risks and hazards:

1. Introduction of new techniques, including more widespread and aggressive fire protection, and improved fire prevention and patrol measures.

2. More and better suppression equipment. The agencies concerned have established an air tanker base at Elko, to be used on the suppression of wild fires.

3. Recognition of high hazard areas from the study of past fire occurrence maps and fuel type maps.

4. Intensified and more diligent inspection and hazard elimination along the Southern Pacific and Western Pacific rights-of-way. Insist that railroads adhere closely to the Nevada fire laws with respect to fireproofing of diesel locomotives. Trucking firms and contractors using internal-combustion equipment should also be checked for compliance with this section of the fire laws.

5. Use of improved national fire danger rating systems.

6. Improved fire detection and radio communications.

7. Inclusion of cooperator ranch crews in Federal and State fire control organizations.

WATERSHEDS WITH OPPORTUNITIES FOR PROJECT-TYPE DEVELOPMENT

The Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, as amended) authorizes the Secretary of Agriculture to give technical and financial help to local organizations in planning and carrying out works of improvement in watershed or subwatershed areas of 250,000 acres or less. These projects are for: (1) flood prevention; (2) the agricultural phases of water management; (3) public recreational development; and (4) other purposes, such as municipal and industrial water supplies, and improvement for fish and wildlife.

Project works of improvement include land treatment measures and individual structures having not more than 5,000 acre-feet of flood-water detention capacity, or not more than 25,000 acre-feet of capacity for all purposes.

Watershed projects provide a means for accelerating coordinated scheduling and installation of needed improvements on public and private lands.

The problems in at least one watershed are such that they can best be handled on a project basis. Projects in this watershed would provide for watershed protection, flood control, municipal water supply, public recreation development, and reduce erosion.

Elko Watershed

The Elko watershed is located in an area surrounding major portions of the City of Elko. It comprises all the drainages north of the Humboldt River from East Adobe Creek on the west to and including Kittridge Creek on the east. It also includes South Side Wash south of the Humboldt River. The area encompasses about 28,800 acres. About 38 percent of the land is national land reserve and 62 percent is privately owned.

The predominant plant cover on the range land is big sagebrush-grass. The grasses consist mostly of cheatgrass, with small amounts of Sandberg bluegrass, bottlebrush squirreltail, needlegrass and ryegrass. The perennial grasses, primarily bluebunch wheatgrass and Nevada bluegrass, which once constituted the plant understory of this site have largely disappeared.

At present 100 percent of the range is in a low forage production class. The proposed treatment measures would change this condition to place 25 percent of the range in a fairly high forage production class, 25 percent in the medium, and reduce the low forage class by 50 percent.

Flood water, erosion, and sediment damage are the primary features of the project watershed. Floods of February 1910, August 1961, and February 1962 caused widespread damage to property in the City of Elko. Along with the suggested watershed treatment, a detention dam or dams across Fifth Street Wash and Eight Mile Creek, and a retarding structure across South Side Wash are proposed which would be used for flood water control and sediment storage.

Another feature of this project watershed is the storage of water on Kittridge Creek for the purpose of supplementing the municipal water supply and developing a fishery and recreation area.

This watershed yields only a small amount of water except during high-intensity storm periods. The annual water balance study indicates that during an 80 percent frequency flow year water yield to the Humboldt River might be in the range of zero to 50 acre-feet. Practically all the precipitation during this frequency year is either retained in the soil and consumptively used by plants, or is lost by direct evaporation. During occasions of high intensity storms, however, when the surface soil is saturated or frozen, the runoff is great.

A preliminary evaluation of the works of improvement proposed for this watershed is sufficiently favorable to warrant a more detailed study. (For more detailed information see Elko Watershed, Appendix I.)

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APPENDIX I

Pertinent elaborative material of value to the general reader, for his reference and guidance in the use of the reach report.

CONTENTS

INITIATION OF ACTION
for
PROJECT- TYPE DEVELOPMENT

Accomplishing the Improvements, Public Law 566

The development of project operations would need to be initiated by a local sponsoring organization representing the landowners and operators. The sponsoring organization could initiate such action by submitting an application for watershed planning assistance to the Director of the State Department of Conservation and Natural Resources.

Under the provisions of the Watershed Protection Act, and the operations procedures as developed by the U. S. Department of Agriculture, a local sponsoring organization would provide needed land rights for structural improvements, and assume the responsibility for contracting the structural work and for its subsequent operation and maintenance.

The landowners would have responsibility for the installation of land treatment measures on the privately owned lands. Cost-sharing and credit assistance could be made available by the U. S. Department of Agriculture for such work.

The Bureau of Land Management would assume responsibility for the installation of land treatment measures on the Federal lands, which would be accomplished with the usual participation in costs by the range users.

Funds appropriated under the Watershed Protection Act can be made available to defray the cost of construction of the structural improvements for the reduction of floodwater and sediment damages and to share in the construction cost of structural improvements for irrigation, drainage, fish and wildlife, and other recreation features. These funds may also be used to provide cost-sharing assistance to local sponsors for the acquisition of land, easement and rights-of-way needed for public recreational developments. In addition, Public Law 566 funds are available for installing land treatment measures on Federal lands which are intended primarily for the improvement of vegetal cover (range seeding and brush-spraying).

ELKO WATERSHED

Physical Features of the Watershed

Location

The Elko Watershed is in the central part of the Elko Reach, in an area surrounding a major portion of the City of Elko. It includes the drainages of East Adobe Creek, Fifth Street Wash, Eight Mile Creek, Manzanita Wash, and Kittridge Creek which are north of the Humboldt, and South Side Wash, south of the Humboldt.

Geology

Consolidated sedimentary rocks of Paleozoic age including quartzite, conglomerate, chert, and shale crop out or lie at shallow depths in the highlands. Upland areas, including tilted bench tops and slopes adjacent to drainages, are underlain by partially consolidated deposits of Tertiary age. The Tertiary deposits consist of alluvial and lake sediments and interbedded fragmental volcanic materials. These volcanic materials crop out in the mountain highlands and consist largely of tuff, or cemented volcanic ash, and some agglomerate. Some of the upland surface soils are developed on the Tertiary deposits or a thin veneer of more recent deposits overlying the Tertiary deposits. Mostly unconsolidated alluvial deposits of Quaternary age overlie the Tertiary deposits in the valley bottomland.

Soils

The soils in general are moderately deep to deep, medium and gravelly medium textured, and well drained. There are some bottomland soils that are imperfect to poorly drained, with slight salt and alkali concentrations. The upland bench and terrace lands have some soils that are moderately fine textured, moderately well drained, with a strongly cemented hardpan at moderate depth and strong alkali concentrations in the subsoil. There are also some shallow soils on the ridges that are stony and gravelly medium textured and excessively drained.

Vegetation

The predominant plant cover over much of the watershed consists mostly of big sagebrush-grass. Within this site, low sagebrush-grass is found on the shallow droughty soils. Desirable perennial grasses - bluebunch wheatgrass and Nevada bluegrass - which once constituted the bulk of the understory have nearly disappeared. At present, cheatgrass and annual weeds make up the principal grass understory. A large burned area is covered with an almost pure stand of cheatgrass and annual weeds.

Along the Humboldt bottomland and in the valley bottoms, such as along East Adobe and Kittridge Creek, rabbitbrush with a ryegrass understory make up the principal cover.

Climate

There is a precipitation and temperature gaging station at the Elko Airport and a precipitation storage gage on Adobe Summit, all within the watershed boundary. These records by the U.S. Weather Bureau indicate the average annual precipitation at Elko to be 8.6 inches (93 years of record) and 9.2 inches (nine years of record) on Adobe Summit, elevation 6,560 feet. The growing season for Elko (28 degrees F) would be about 116 days (41 years of record). Most of the moisture falls in the form of snow during the winter months.

Annual precipitation extremes vary from .94 inches in 1872 to 18.94 inches in 1904. Monthly extremes vary from zero (several years of record) to six inches in January 1903. The maximum 24 hour precipitation recorded is 3.3 inches, which occurred during April 1925.

Land Status and Use

The land status and use breakdown is as shown below:

Land Status	Acres	Land use			
		Range land		Municipal	
		Acres	%	Acres	%
National Land Reserve	10,700	10,700	42	-----	--
Elko Indian Colony	200	------	--	200	6
Private	17,400	14,000	56	3,400	94
County and State	500	500	2	-----	--
Total	28,800	25,200	100	3,600	100

Other than the municipal land, the private land is divided among an estimated 25 land owners, including 2,235 acres owned by the railroad.

Federal and private range lands are used for spring-fall and summer range for domestic livestock and big game; as a year long range for other wildlife, and as a watershed area.

Water Supply and Use

The entire area is subject to high intensity, short duration storms. However, normally the annual water yield from the watershed is quite low. An 80 percent frequency yield to the Humboldt River would be in a range of zero to 50 acre-feet. Springs in upper Kittridge Creek have a gross yield of about 220 acre-feet annually. There are no perennial streams in the watershed. The few drainages that have some water are normally dry a short distance below their spring-fed sources.

At the present time there is no agricultural land irrigated in the watershed. The precipitation that falls on the area is either retained in the soil and used by plant cover, runs off as surface flow to Humboldt River, or goes into ground water storage. Some of the flow from the springs in Kittridge Creek is piped into the City of Elko.

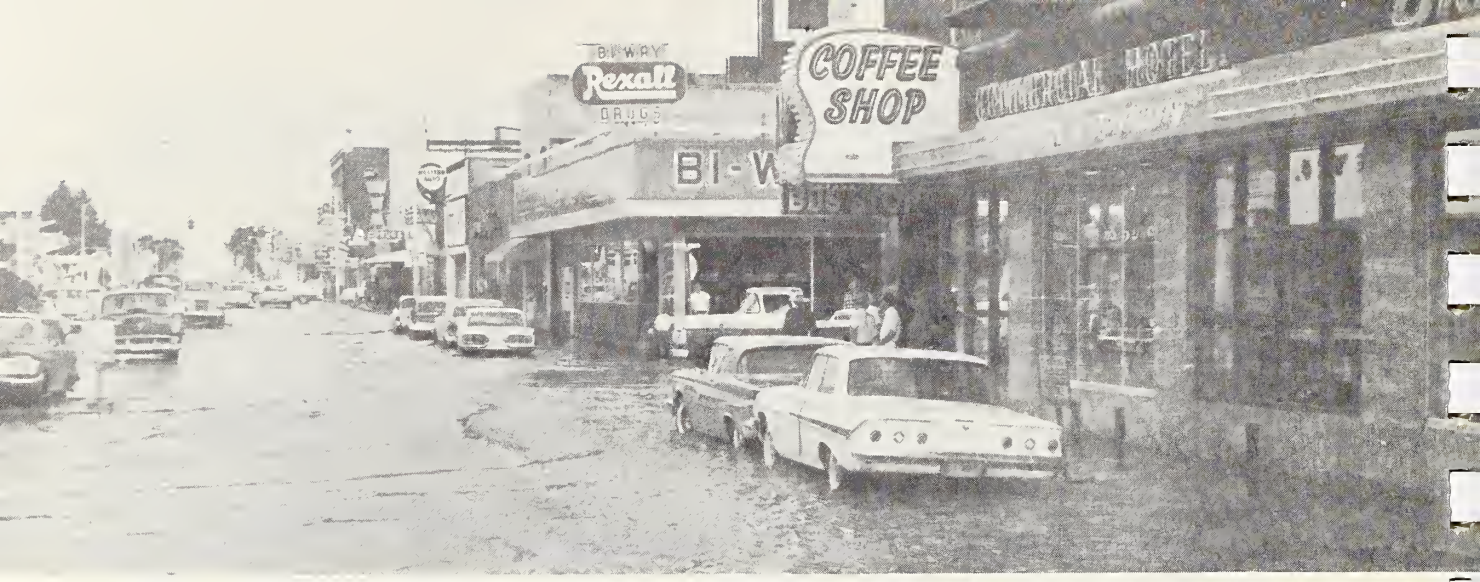
Water Needs for Recreation Areas and Special Use Sites

At present there are no developed recreation areas or special use sites in the watershed. The City of Elko plans to develop a camp, picnic sites, and public fishing area adjacent to the springs on Kittridge Creek; this use will require a portion of the springs' flow.

Watershed Problems

Agricultural Water Management

There are no lands being irrigated for hay production at the present time. The flood plain lands along the Humboldt, however, are used for pasture.



Photograph 24. - Dry-mantle floodwaters in downtown Elko, August 6, 1961. Looking eastward along Idaho Street at Fourth. The basements of the Commercial Hotel, the Bi-Way Drug Store, and other businesses along Idaho and adjacent streets in the business district were flooded with water and mud. EARL A. FRANTZEN PHOTO

Flood Water, Erosion and Sediment Damage

The main problems of the watershed concern flood water and sediment other than that caused by the flows in the Humboldt River. Extensive floodwater and sediment damage is caused to the City of Elko from side drainages.

Floods of August 1961 were from local thunderstorms on normally dry washes, which became torrents during each downpour. This series of storms caused flood channels to overflow and storm sewers to clog. The County Fairground, the city-owned Ruby View Golf Course, the City Park, streets, highways, basements and first floors of commercial and residential properties were flooded. (See photograph 24.)

Floods of February 1962 were caused by rain-on-winter snow. The damage from this event was similar but less severe than those in 1961.

Other Problems

These problems concern the need for additional water to supplement the municipal water supply and the desire of the city to establish a picnic and camping area for local residents and tourists.

Vegetation - Kind and Condition

Phreatophytes

The only phreatophyte area of any consequence is along the Humboldt River. This area, which once was a ryegrass meadow, is now covered with rabbitbrush, some greasewood and a few small stringers of willows. Ryegrass is the understory to these shrubs.

Range Forage Production

Table 5 presents information on the range forage production acreage, present and potential, for the Elko watershed. The entire watershed is in the low forage production

Table 5. -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Elko Reach .

Vegetol type and site	Present annuol forage plant productian classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Rabbitbrush-greasewood-grass; saline bottomlands	Productian classes (paunds per acre) 1/			Production closses (paunds per acre) 1/			
Soil assaciations	850-1,500	200-900	20-300	850-1,500	200-900	20-300	
H1-H4	-----	-----	600	-----	600	-----	Management.
Subtotal	-----	-----	600	-----	600	-----	
2. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/			Production closses (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	Three stock water develapments, six miles of fencing, management, 6,000 acres seeding.
S4-S10-Y2	-----	-----	10,000	6,000	1,000	3,000	
B4-R10-L4	-----	-----	200	-----	-----	200	
Subtatal	-----	-----	10,200	6,000	1,000	3,200	
3. Law sagebrush-grass; claypan bench	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associatians	200-500	100-250	50-150	200-500	100-250	50-150	
C4-B10-L11	-----	-----	1,400	-----	400	1,000	Monagement.
Subtotal	-----	-----	1,400	-----	400	1,000	
4. Brawse-aspen-grass; intermediate mountain slapes	Productian classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Sail associatians	300-650	150-350	50-200	300-650	150-350	50-200	
C4-B10-L11	-----	-----	12,600	-----	4,000	8,600	Monagement.
Subtotal	-----	-----	12,600	-----	4,000	8,600	
5. Pinyon-juniper-grass; shollow stony slapes	Productian classes (pounds per acre) 1/			Production classes (pounds per ocre) 1/			
Soil ossaciations	100-250	50-150	10-75	100-250	50-150	10-75	
B4-R10-L4	-----	-----	400	-----	100	300	Management.
Subtatal	-----	-----	400	-----	100	300	
Total	-----	-----	25,200	6,000	6,100	13,100	

1/ These figures indicate total annual forage productian (dry weight), and will be used as a basis for planning needs anly. Foroge production figures will not be used for assigning range carrying capocities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, ond the management abjectives of the administrative agency.

These rates represent productian variance from poor years to good yeors. At higher elevations within the site, with greater precipitotion the rates would be higher, and canversely far lower elevations.

Source: Humboldt River Basin Field Party.

class. A considerable acreage within the watershed boundaries was burned by a fire starting July 8, 1947. Today in the burned area there has been little or no re-establishment of big sagebrush or perennial grasses. Cheatgrass composes at least 95 percent of the vegetation within the burned area.

Vegetal cover on the rest of the watershed area consists of big sagebrush, low sagebrush, scattered bitterbrush, and juniper, with big sagebrush being the most prevalent. With the exception of bitterbrush, these species have little value as effective watershed cover or as soil-binders. Only scattered remnants of the better forage and soil-binding grasses, such as bluebunch wheatgrass, Nevada bluegrass, Great Basin wildrye, needle-and-thread grass, and Thurber needlegrass can be found.

The principal grass species are cheatgrass, Sandberg bluegrass, and thickspike wheatgrass. In addition, there are significant amounts of bitterbrush outside the burned area, at the higher elevations.

In general, the watershed is in a deteriorated condition, with a poor cover of perennial plants. Accelerated sheet erosion and class 2 gully erosion are in evidence throughout the watershed area.

Opportunities for Development

Flood Control

It is proposed that earth-fill detention dams be constructed across Fifth Street Wash and Eight Mile Creek just above the City of Elko. It would be possible to construct these dams as two separate units, or as a single unit, whichever is found to be the most practical. The height of the structure or structures would be designed to control one percent frequency storms (storms that could be expected to occur once in a hundred years). The structure or structures would be from 60 to 65 feet high, have an estimated total length of 3,000 feet, and a total retention capacity of approximately 1,500 or 2,000 acre-feet.

It is also proposed that a retention dam of compacted earth fill be constructed across Southside Wash. This structure would be approximately 25 or 30 feet high.

Municipal Water and Public Recreation Development

An earth dam across the upper end of Kittridge Creek is proposed which would store water from Kittridge springs and runoff from the drainage. At the present time the City of Elko is diverting some of the spring water by way of a pipe line to supplement the municipal water supply. This dam, for municipal and recreational uses, would probably be between 50 and 60 feet high and have a capacity of between 200 and 300 acre-feet.

Watershed Protection and Improvement

There are an estimated 6,000 acres of Federal and private range land that are considered suitable for seeding. An improved grass cover, plus necessary fencing, water development, fire protection, and improved management practices are considered necessary for minimum watershed protection.

Benefits Expected

Flood Prevention and Sediment Damage Control

The proposed dam or dams on Fifth Street Wash and Eight Mile Creek would provide flood protection for the City of Elko, U.S. Highway 40, and two railroads, Southern Pacific and Western Pacific. The average annual damage, based on data from the floods of 1961 (10 percent frequency) and 1962 (33 percent frequency), was estimated to be between $50,000 and $60,000.

The proposed dam on Southside Wash would provide flood protection for a residential area in the southern part of the City of Elko.

Watershed Protection and Improvement

Treatment measures proposed would result in better protection for the watershed through reduced erosion, and help to reduce management problems through better control of seasonal grazing.

Municipal Water and Public Recreation Developments

The dam proposed on Kittridge Creek would provide storage for water which would increase the supply needed to supplement the municipal water supply, and provide a public fishery, camp and picnic area for local residents and tourists.

Conclusions

A preliminary evaluation of the proposed works of improvement is sufficiently favorable to warrant a more detailed study, to determine the feasibility of a watershed project. At this writing an application for assistance in the development of a plan for a watershed protection and flood prevention project has been submitted by the local people to the Secretary of Agriculture. Planning assistance for the development of such a plan has been authorized.

SOILS DESCRIPTION

The generalized soil survey of the Elko Reach of the Humboldt River shows the location and distribution of different kinds of soils by associations of Great Soil Groups. Each Great Soil Group includes a number of soils with similar internal characteristics that reflect the environmental conditions responsible for their development. Great Soil Groups mapped in the survey include:

Alluvial Soils (Symbol: A)

These are the soils that consist of essentially recent stream-laid deposits: alluvial fans, floodplains, terraces and basins. They have essentially no profile development, but a little organic matter may have accumulated. They are usually deep, stratified, variable with regard to drainage class, and occur under many different climatic conditions.

Brown Soils (Symbol: B)

These are the soils which have dark brownish A horizons about six inches thick, textural B horizons 10 to 15 inches thick, and calcareous parent material of variable thickness. Some of these soils have cemented calcium carbonate layers in the C horizon and some may have the C horizon resting on bedrock. They are usually moderately deep to deep, well drained, and occur under a cool semi-arid climate with an average precipitation of seven to 20 inches.

Chestnut Soils (Symbol: C)

These soils have dark grayish brown to very dark grayish brown A horizons about six to eight inches thick, textural B horizons 10 to 15 inches thick, and parent material that may or may not be calcareous. These soils usually have darker A horizons, more organic matter, and have been more strongly leached than have Brown Soils. The parent material may or may not rest on bedrock. They are usually moderately deep to deep, well drained, and occur in a cool semi-arid climate with an average precipitation of about eight to 25 inches.

Humic Gley Soils (Symbol: H)

These are the dark brown or black meadow soils that grade into lighter colored or rust-mottled grayish soil at depths of one to two feet. They are imperfectly to poorly drained, usually with seasonal fluctuating high water table, and occur along stream floodplains where they are subject to overflow. They occur in a cool semi-arid climate.

Lithosols (Symbol: L)

These soils have an incomplete profile, or no clearly expressed morphology. They are shallow (less than 10 to 15 inches), and consist of freshly and imperfectly weathered masses of hard rock or hard rock fragments, and are largely confined to steeply sloping lands. In the higher rainfall areas of the sub-basin, some of these soils may have dark A horizons. They are usually excessively drained.

Regosols (Symbol: R)

These are soils which consist of deep unconsolidated deposits, in which few or no clearly expressed soil characteristics have developed. They are largely confined to collu-

vial accumulations on steep mountain slopes. Under eight to 10 inches rainfall, the Regosols may have only a weakly developed A horizon, while in higher rainfall areas they may have well developed dark A horizons six to 14 inches or more thick. In mountainous areas these soils may be underlain by bedrock 15 to 20 inches below the soil surface.

Sierozems (Symbol: S)

These are soils with pale grayish or light brownish surface soils and textural B horizons closely related in color to the surface soil. They are usually calcareous in the B horizon, and frequently also in the surface soil. They quite often have a cemented calcium carbonate hardpan at shallow to moderate depths below the B horizon. The B horizon in the Sierozem Soils in this sub-basin is usually weakly developed and difficult to identify. In mountainous areas the Sierozems may be underlain by bedrock at moderate depths. These soils are found in a semiarid cool climate, with an average annual precipitation of about seven to 13 inches.

Solonetz (Symbol: Y)

These are imperfectly drained soils with a very few inches of light grayish or brownish surface soil underlain by a hard columnar fine-textured horizon that is high in exchangeable sodium. They occur on floodplains, terraces, and some alluvial fans, usually as small areas associated with saline-alkali Alluvial Soils, Humic Gley Soils, and Calcium Carbonate Solonchaks.

Mapping Units

Mapping units on the generalized soil survey map of the Elko Reach are associations of phases of Great Soil Groups that reflect characteristics of soils significant to use and management. Each mapping unit symbol includes the designation of approximate composition for each Great Soil Group that comprises the association.

Example: $\frac{\text{B1-R1-L4}}{\text{50-30-20}}$

SOILS TABLES

The following tables, 6 and 7, show the general soil characteristics and the interpretations for each Great Soil Group phase which was mapped in the reach.

Table 6. -- Soil characteristics, Elko Reach

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope range %	Erosion	Salt & alkali	Drainage	Remarks
A2	Deep	Medium and gravelly medium	Medium	2-15	Slight	None	Well	25% stony soils, seedable
B1	Moderately deep to deep	Medium	Medium to moderately fine	30-50	Slight 15% mod.	None	Well	Hill creep
B2	Moderately deep to deep	Medium	Medium to moderately fine	4-15	Slight 5% mod.	None	Well	Small areas cropland, seedable
B4	Deep	Stony medium moderately fine	Moderately fine to fine	20-40	Slight 10% mod.	None	Well	5% Chestnut 5% Sierozem
B10	Moderately deep	Medium stony	Fine over hardpan	10-30	Slight 5% mod.	None	Well	
C4	Deep	Medium	Moderately fine to fine	16-50	Slight 5% mod.	None	Well	20% stony
H1	Deep	Medium	Medium	0-2	Slight	Slight	Imperfect	Overflowed
H2	Deep	Medium	Medium	0-2	Slight	None	Imperfect to poor	
H4	Deep	Medium	Medium to moderately fine	0-2	Slight	None	Poor	Overflowed
H5	Deep	Medium to moderately fine	Medium and moderately fine	0-2	Slight	None	Imperfect to poor	Overflowed
H6	Deep	Medium to moderately fine	Medium and moderately fine	0-2	Slight	Slight to moderate	Imperfect to poor	Overflowed
L1	Shallow over bedrock	Stony and rocky medium		50-70	Slight 20% mod.	None	Excessive	10% rock outcrop
L4	Shallow over bedrock	Stony and gravelly medium		30-60	Slight	None	Excessive	

Continued

Table 6. -- Soil characteristics, Elko Reach

Soil Phase	Depth	Texture: Surface	Texture: Subsoil	Slope range %	Erosion	Salt & alkali	Drainage	Remarks
L6	Shallow over bedrock	Stony and gravelly medium		50-75	Moderate 20% sev.	None	Excessive	10% rockland
L11	Shallow over bedrock	Stony and gravelly medium		10-30	Slight 10% mod.	None	Excessive	10% rockland
R1	Moderately deep to deep	Stony and gravelly medium	Stony and gravelly medium	30-60	Slight 15% mod.	None	Somewhat excessive	
R10	Deep	Gravelly and stony medium	Medium	40-60	Slight 20% mod.	None	Somewhat excessive	
S3	Moderately deep to deep	Stony medium	Medium	15-30	Slight 15% mod.	None	Well	
S4	Moderately deep to deep	Medium	Medium	2-15	Moderate gullying	None	Well	20% stony soils
S8	Moderately deep	Gravelly medium	Gravelly medium	20-40	Moderate	None	Well	10% stony soils
S10	Moderately deep over hardpan	Medium	Moderately fine	10-30	Slight 15% mod.	None	Well	50% seedable
S11	Moderately deep over hardpan	Medium	Moderately fine	3-10	Slight	None	Well	5% saline-alkali Solonetz, 60% seedable
Y2	Deep	Medium to moderately fine	Moderately fine and fine	0-3	None	Strong alkali in subsoil	Moderately well	10% saline-alkali soils

Source: Humboldt River Basin Field Party.

Table 7. -- Interpreted soil characteristics, Elko Reach

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC [1/] (inches)	Soil Hydrologic Group	Capability subclass	Major land use	Dominant vegetation
A2	8-10	Slight	8	B	VIc	Range	Big sage-grass
B1	7-15	Moderate	4	C	VIIe	Range	Big sage-grass
B2	7-10	Moderate	6	C	VIc	Range	Big sage-grass
B4	7-15	Slight	8	C	VIIs	Range	Big sage-grass, juniper-grass
B10	8-15	Slight	5	D	VIIs	Range	Low sage-grass
C4	7-15	Slight	8	C	VIIe	Range	Big sage-grass
H1	7-10	Slight	12	B	IIw	Meadow hayland and pasture	Meadow-grass
H2	7-10	Slight	12	B	IIw	Meadow hayland and pasture	Meadow-grass
H4	7-10	Slight	10	C B	IIIw	Meadow hayland and pasture	Meadow-grass
H5	8-10	Slight	10	B	IIIw	Meadow hayland and pasture	Meadow-grass
H6	8-10	Slight	10	B	IVw VIw	Range and meadow	Rabbitbrush, giant wildrye, saltgrass
L1	7-15	Moderate	1.5	D	VIIs	Range and watershed	Low sage-grass
L4	8-15	Slight	1.5	D	VIs	Range and woodland	Big sage-grass, juniper-grass
L6	9-12	Severe	1.5	D	VIIs	Range	Big sage-grass, juniper-grass
L11	8-15	Moderate	1.5	D	VIIs	Range and watershed	Big sage-grass
R1	8-10	Moderate	6	C	VIIe	Range and watershed	Big sage-grass, mixed browse-grass
R10	7-15	Moderate	7	C	VIIe	Range	Big sage-grass
S3	9-12	Moderate	4	C	VIc VIIe	Range, nonstony areas seedable	Big sage-grass

Continued

Table 7. -- Interpreted soil characteristics, Elko Reach -- Continued

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC 1/ (inches)	Soil Hydrologic Group	Capability subclass	Major land use	Dominant vegetation
S4	8-10	Moderate	6	C	VIc VIIe	Range, nonstony areas seedable	Big sage-grass
S8	7-12	Slight	4	D	VIIe	Range	Big sage-grass
S10	8-12	Moderate	7	C	VIc	Range	Big sage-grass
S11	7-10	Moderate	7	C	VIc	Range	Big sage, juniper-grass
Y2	7-10	Moderate	12	D	VIIs	Range	Big sage-grass

1/ Available water holding capacity.

Source: Humboldt River Basin Field Party.

DEFINITIONS

HYDROLOGIC SOIL GROUP

Watershed soil determinations are used in the preparation of hydrologic soil cover complexes, which in turn are used in estimating direct runoff. Four major soil groups are used. The soils are classified on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling and without the protective effects of vegetation.

Group A - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively well drained sand or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.

Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and slow infiltration rate. These soils have a slow rate of water transmission.

Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with a claypan or clay layer at or near the surface; and (4) shallow soils having a very slow rate of water transmission.

LAND USE CAPABILITY CLASSES AND SUBCLASSES

The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and production on the farm or ranch.

The classification contains two general divisions: (1) land suited for cultivation and other uses; and (2) land limited in use and generally not suited for cultivation. Each of these broad divisions has four classes which are shown by a number. The hazards and limitations in use increase as the class number increases. Class 1 has few hazards or limitations, or none, whereas Class VIII has a great many.

Capability classes are divided into subclasses. These show the principal kinds of conservation problems involved. The subclasses are "e" for erosion, "w" for wetness, "s" for soil, and "c" for climate.

Capability classes and subclasses, in turn, may be divided into capability units. A capability unit contains soils that are nearly alike in plant growth and in management needs.

Land Suited for Cultivation and Other Uses

Class I	Soils in Class I have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland or wildlife.
Class II	Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.
Class III	Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.
Class IV	Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Land Limited in Use; Generally Not Suited for Cultivation

Class V — Soils in Class V have little or no erosion hazard but have other limitations that prevent normal tillage for cultivated crops. They are suited to pasture, woodland, range, or wildlife.

Class VI — Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

Class VII — Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

Class VIII — Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

ANNUAL WATER BALANCE STUDY - 80% FREQUENCY

Annual water balance, as used in these studies, is the evaluation of a portion of the hydrological cycle. The cycle starts with precipitation on the watershed, and ends with the runoff, both surface and subsurface flow, after subtracting water uses and losses.

The annual water balance was calculated for an 80 percent frequency (expected to be equaled or exceeded eight out of 10 years). This frequency was used because normally such a water supply would be the quantity needed to justify land and irrigation improvements on ranches growing high-yielding forage crops.

Values obtained using this procedure are approximations. Accuracy would depend on the reliability of the basic soils, vegetation, and hydrologic data used, and would normally be in the range of 60 to 90 percent. Because of the relatively small area with short drainages and limited data, the accuracy of the estimated water yield from the watersheds in this reach of the Humboldt River could be less than has been experienced in other sub-basins. The small amount of yield from this area, however, would have little effect on the percent accuracy of the computed flow at the Palisade gage. The results of the combined studies above Palisade check very well with the gaged flow at this point.

Water yield data are not available on the watersheds in the Elko Reach of the Humboldt River, except for some early season weekly readings taken in 1952-1953-1954 on eight drainages (Marys, East Adobe, Eight Mile, Kittridge, Wright, Sheep, Sherman, and Jackstone Creeks). The records show no surface flow reaching the Humboldt during 1953 and 1954. These years were computed to be 65 and 90 percent frequency flow years, respectively, at the Palisade gage. U. S. Geological Survey streamflow records at Ryndon (25 years), Elko (seven years), Carlin Canyon (19 years), and Palisade (56 years) were used to estimate the 80 percent flow in the Humboldt River.

The available information used for determining precipitation in the watershed areas consisted of a storage gage at Adobe Summit (nine years), and precipitation stations at Deeth (10 years), Halleck (33 years), Elko (93 years), Carlin (31 years), Palisade (24 years), and Emigrant Pass (nine years). These data gave an indication of the annual precipitation. The precipitation used in the water balance studies was determined as the quantity needed to produce the 80 percent frequency outflow to the Humboldt River after subtracting the water uses and losses.

Calculations for the water balance in the reach included the following assumptions: (1) the several hot springs around Elko and Carlin originate outside the reach; and (2) flow from Carlin (Dwyer) Springs, west of Carlin, is either part of the return flow from the Humboldt River or part of the yield from other sub-basins in the Humboldt Basin. The flow from springs at the mouth of the South Fork of the Humboldt River is a part of the discharge from that drainage.

The acreage of land irrigated during an 80 percent frequency year was difficult to determine in this area. The estimated 14,200 acres were considered to be reasonable after a review of aerial photographs, field checks, conservation plans, and other data.

All the land with water rights may or may not receive surface irrigation every year; this would depend on priority of use and available water, and on the transfer of water from one field to another.

A flow diagram of water yields and depletion, with quantities in acre-feet, is shown in figure 2. Table 8 is a summary of the water balance studies by elevation zones for watersheds. The difference in water yield, inches per acre, is caused by the difference in watershed characteristics. These characteristics include (1) precipitation; (2) soil development; (3) condition and species of plant cover; and (4) the physical features of the drainage.

The annual water balance inventories by watersheds were made to find answers to the following questions:

1. What is the gross water yield of the watersheds in the reach? Gross water yield, for the purpose of this study, is the estimated available water, both surface and sub-surface, prior to agricultural and phreatophytic use. Generally, this water yield is estimated for a stream or streams at a point above the highest diversion for the main body of irrigated land on a flood plain of a valley.

2. What is the magnitude of water use and loss by each of the major ground cover types?

3. Where are the water-yielding areas in the reach and in each watershed?

4. Can vegetal manipulation be used to increase water supply for beneficial use?

The reach was divided into three watersheds, in order to obtain a more accurate estimate of water yield, uses and losses. They are: (1) Deeth to Ryndon; (2) Ryndon to Carlin Canyon; (3) Carlin Canyon to Palisade.

The results of the water balance studies indicated the following:

1. The 80 percent gross water yield (surface and subsurface) originating in the reach was estimated to be 500 acre-feet.

2. The estimated surface and ground water uses, losses, and discharge were as follows: Irrigated crops, 19,600 acre-feet on 14,200 acres; municipal water supply, 1,000 acre-feet; all phreatophytes, 6,900 acre-feet on 9,200 acres; evaporation from water surface during high water period, 4,000 acre-feet; and discharge of the Humboldt River at Palisade 116,000 acre-feet.

3. The drainages along the north side of the river plus the inflow from Grindstone Mountain contribute practically all the gross water yield from the reach.

4. Phreatophytes of low economic value, consisting of willow, rose, greasewood, rabbitbrush, and saltgrass, use an estimated 5,400 acre-feet of water annually.

Table 8. -- Summary of Water Balance Studies by elevation zones for watersheds in the Elko Reach for an 80% frequency 1/ 2/

Elevation zone (feet)	Deeth to Ryndon: Acres	Water Yield: in./ac.	Water Yield: acre-feet	Ryndon to Carlin Canyon: Acres	Water Yield: in./ac.	Water Yield: acre-feet	Carlin Canyon to Palisade: Acres	Water Yield: in./ac.	Water Yield: acre-feet
7,000-8,000	------	---	---	3,000	.60	150	1,100	.54	50
6,000-7,000	4,350	.30	110	39,200	.14	470	12,400	.14	140
5,000-6,000	68,750	---	-80	126,800	---	-310	41,200	---	-60
4,000-5,000	------	---	---	4,400	---	---	8,800	---	---
Total	73,100		30	173,400		310	63,500		130
Gross Water Yield:			30			310			130
Inflow: North Fork Sub-Basin			17,930	Humboldt R. at Ryndon		75,550	Humboldt R. at Carlin Canyon		112,700
Mary's River Sub-Basin			21,130	So. Fork Humboldt R.		50,660	Maggie & Susie Creeks		6,340
Starr Creek Watershed			17,010	Hot Springs		730	Hot Springs		730
Lamoille, Secret-Soldier, Rabbit Cr. Watersheds			32,480						
Uses and losses:									
Irrigated cropland (7,000 ac.)			-9,130	(6,000 ac.)		-8,650	(1,200 ac.)		-1,800
Phreatophytes (2,700 ac.)			-2,400	(4,800 ac.)		-3,600	(1,700 ac.)		-900
Surface water evaporation			-1,500			-1,500			-1,000
				Elko Municipal Water		-800	Carlin Municipal Water		-200
Discharge: Humboldt River at Ryndon USGS gage			75,550	Humboldt River at Carlin Canyon USGS gage		112,700	Humboldt River at Palisade USGS gage		116,000

1/ Values in this table when referred to in the text are rounded.

2/ See Water Supply Data, Appendix II.

Source: Humboldt River Basin Field Party.

FOREST SERVICE REGION FOUR
CHANNEL CONDITION CLASSIFICATION CRITERIA

The following describes a method of classifying the condition of perennial or intermittent stream channels. Channel condition, as used here, is measured by indicators of channel stability. Classification is not based on any one factor; all the criteria must be weighed before a decision is reached.

Class 1 - Good

1. Channel sides well vegetated.
2. No slumping of channel sides.
3. Very little or no cutting or deposition of channel bottom.
4. Aquatic vegetation on channel sides and bottom.
5. Algae on rocks.
6. Very little or no recent cutting or deposition along channel sides.

Class 2 - Fair

1. Channel sides partially vegetated.
2. Slumping of channel sides at constrictions and bends.
3. Some cutting of channel bottom at constrictions, bends and steep grades and deposition in areas where the water velocity is less, e.g. pools.
4. Aquatic vegetation scattered, mostly in areas where stream velocities are low.
5. Algae on rocks in places where the bottom is stable.
6. Some cutting of stream banks at constricted areas or at outside of bends; deposition at the inside of bends and at the confluence with other streams.

Class 3 - Poor

1. Very little vegetation on channel sides.
2. Slumping of channel sides common.
3. Cutting and deposition of channel bottom common, bottom obviously in a state of flux.
4. No aquatic vegetation.
5. No algae on rocks.
6. Large-scale cutting of stream banks common.

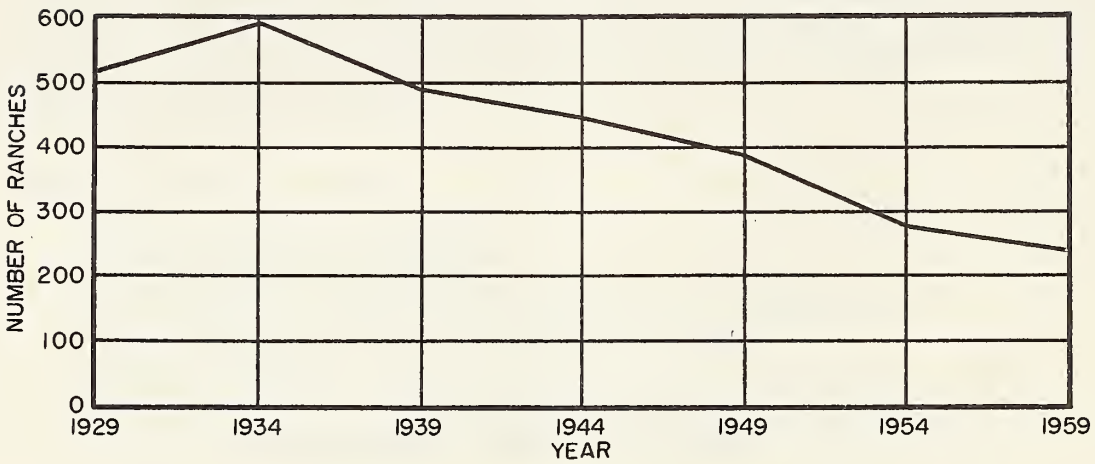
Channels in Rock

In some instances, the channel cross section may be carved in rock. In this case, some of the factors listed under the Fair or Poor class may be in evidence, e.g., lack of vegetation on banks and deposition at grade changes. In order to classify the condition of such channels on the basis of channel stability, they must be considered to be in the Good condition class.

AGRICULTURAL INDUSTRY

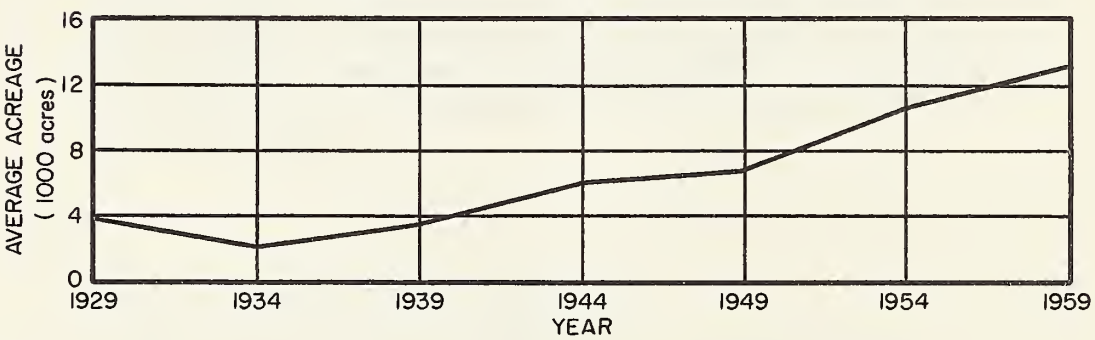
FIGURES AND TABLES

Figure 3. -- Number of ranches in Elko County, Nevada, 1929-59



SOURCE: U. S. CENSUS OF AGRICULTURE

Figure 4. -- Average size of ranch, Elko County, 1929-1959



SOURCE: U. S. CENSUS OF AGRICULTURE

Table 9. -- Selected Ranch Data, Elko County, 1929-59

Item	1959	1954	1949	1944	1939	1934	1929
Farms	238	278	391	443	491	595	518
Land in farms	3,150,967	2,954,706	2,692,149	2,717,767	1,715,186	1,261,796	2,004,716
Average size of farm	13 ,239	10,628	6,885	6,134	3,493	2,120	3,870
Value of land and buildings							
Average per farm	296,483	122,095	53,486	41,862	20,778	14,343	27,139
Average per acre	20.28	12.81	11.41	6.82	5.95	6.76	7.01
Cropland harvested	102,715	130,787	155,274	190,557	171,729	88,936	159,806
Cropland used for pasture only	137,709	68,050	29,537	4,816	110,458	3,100	14,041
Woodland pasture	6,940	2,207	4,534	124	2,179	2,550	1,300
Other pasture	2,859,049	2,738,813	2,488,274	2,511,284	1,421,074	1,146,780	1,780,081
Irrigated cropland harvested	85,928	127,098	153,687	1/	168,446	87,313	1/
Ownership of private land							
Full owner, percent	71.4	74.1	80.8	76.7	82.1	74.4	65.8
Full owner, number	170	206	316	340	403	443	341
Part owner, percent	15.5	14.4	10.0	12.4	5.5	9.4	12.2
Part owner, number	37	40	39	55	27	56	63
Manager, percent	8.4	7.2	5.6	5.0	7.1	9.2	14.1
Manager, number	20	20	22	22	35	55	73
Tenant, percent	4.6	4.3	3.6	5.9	5.3	6.9	7.9
Tenant, number	11	12	14	26	26	41	41
Hired workers	511	626	719	628	871	1,129	

Continued

Table 9. -- Selected Ranch Data, Elko County, 1929-59 -- Continued

Item	1959	1954	1949	1944	1939	1934	1929
Cattle, number	151,092	168,563	150,446	181,608	122,344	128,190	126,472
Cattle, animal units $\frac{N}{1.25}$	120,873	134,850	120,357	145,286	97,875	102,552	101,178
Sheep, number	90,964	121,695	88,453	175,507	128,859	178,400	283,770
Sheep, animal units $\frac{N}{5}$	18,193	24,339	17,691	35,101	25,772	35,680	56,754
Total animal units	139,066	159,189	138,048	180,387	123,647	138,232	157,932
Farms by economic class	190	240	353	377	356		
Class I	84	75	58)				
Class II	44	76	66)	66	25		
Class III	37	38	58	46	32		
Class IV	18	37	64	49	41		
Class V	4	11	75	43	53		
Class VI	3	3	32	169	205		

1/ Information not available.

Source: U. S. Census of Agriculture.

APPENDIX II

This appendix is produced in a relatively limited number of copies. It contains material germane to the Elko Reach but which, because of its detailed or technical nature, is not attached to copies for general distribution.

Such material, however, has potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Elko Reach of the Humboldt River.

CONTENTS

LEGEND

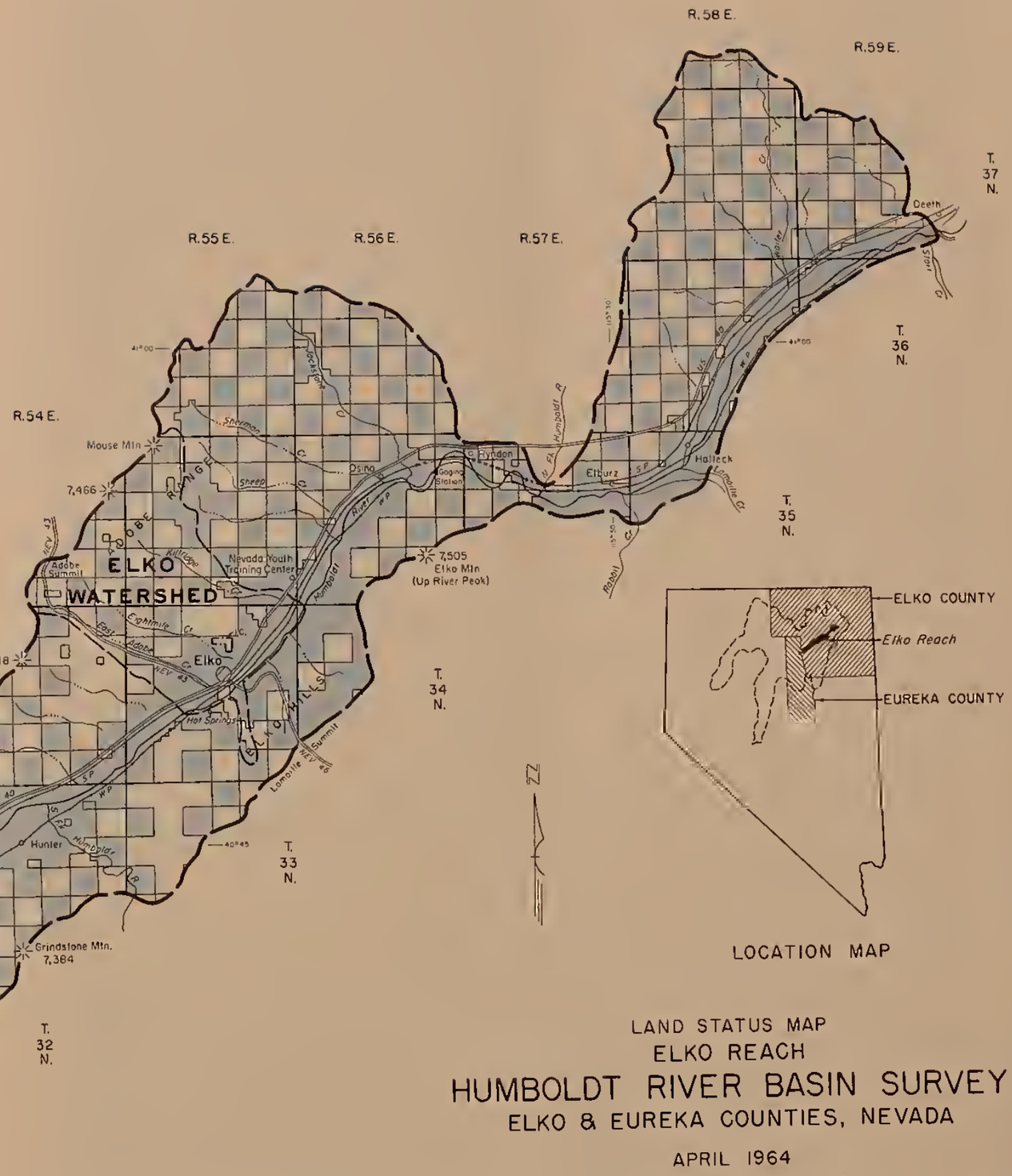
Reoch Boundary

Watershed Boundory

I.C. Elko Indion Colony

Privote Land

Federol Lond



LOCATION MAP

LAND STATUS MAP

ELKO REACH

HUMBOLDT RIVER BASIN SURVEY

ELKO & EUREKA COUNTIES, NEVADA

APRIL 1964

2 0 2 4 6

SCALE IN MILES

7-P-17694-N

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE M-4086

RANGE FORAGE PRODUCTION RATES BY SITES

RABBITBRUSH-GREASEWOOD-GRASS, SALINE BOTTOMLAND (includes some irrigated acreage)

Pounds dry forage per acre
- 550-1,500
- 200- 900
- 20- 300

MEADOW GRASSES-FORBS-SEDGES; SEMI-WET MEADOW

Pounds dry forage per acre
- 1,200-3,000
- 600-2,000
- 200-1,000

BIG SAGEBRUSH-GRASS; UPLAND BENCHES AND TERRACES

Pounds dry forage per acre
- 250-600
- 100-450
- 20-250

LOW SAGEBRUSH-GRASS; CLAYPAN BENCH

Pounds dry forage per acre
- 200-500
- 100-250
- 50-150

PINYON-JUNIPER-GRASS; SHALLOW STONY SLOPES

Pounds dry forage per acre
- 100-250
- 50-150
- 10-75

BROWSE-ASPEN-GRASS; INTERMEDIATE MOUNTAIN SLOPES

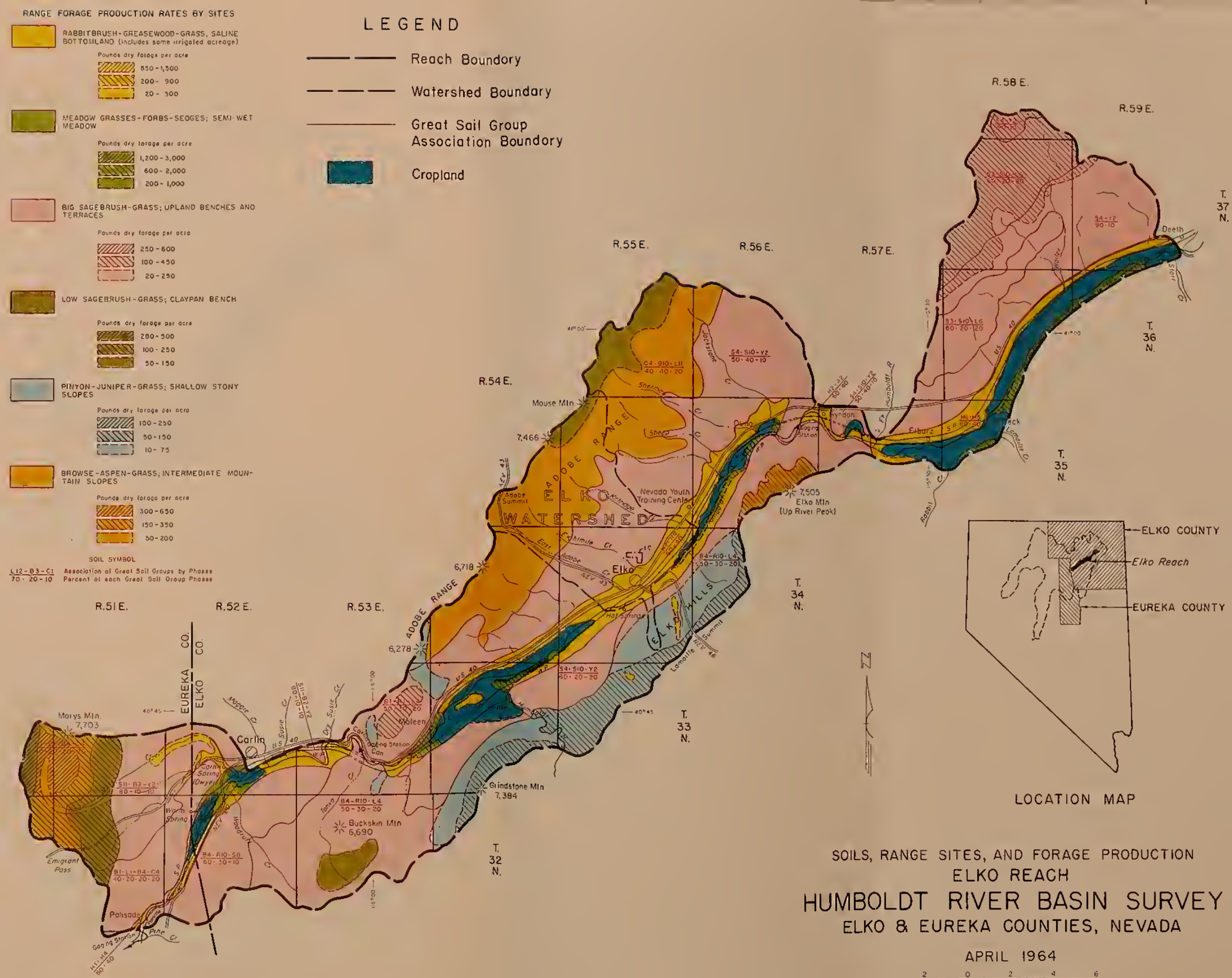
Pounds dry forage per acre
- 300-650
- 150-350
- 50-200

SOIL SYMBOL

$\frac{L12-B3-C1}{70-20-10}$ Association of Great Soil Groups by Phases / Percent of each Great Soil Group Phases

LEGEND

- Reach Boundary
- Watershed Boundary
- Great Soil Group Association Boundary
- Cropland



LOCATION MAP

SOILS, RANGE SITES, AND FORAGE PRODUCTION

ELKO REACH

HUMBOLDT RIVER BASIN SURVEY

ELKO & EUREKA COUNTIES, NEVADA

APRIL 1964

2 0 2 4 6
SCALE IN MILES

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7-P-17694-N

TYPE 2 MEADOW

Ost Oistichtis stricta (inland saltgrass)

Eci Elymus cinereus (Great Basin wildrye)

TYPE 4 SAGEBRUSH

Ari Artemisia tridentato (big sagebrush)

Cna Chrysothamnus nauseosus (rubber rabbitbrush)

TYPE 14 GREASEWOOD

Sve Sarcobatus vermiculatus (black greosewood)

Type Number — Type Aspect — Abundant Species — Percent of Species

Average Total Areal Density

4-Cna-Sve-Eci
08-30-20-15

1. 4·Cna·Sve-Eci / 075·30·20-15
2. 14-Sve-Cna / .065-45-10
3. 4-Cna·Sve-Eci-Dsl / 06·15·10-20-10
4. 4-Cna·Sve·Eci / 06·35·25-10
5. 14·Sve·Cna-Eci / .055·35-10-10
6. 14·Sve·Cna-Eci / 05·35-15-10
7. 14·Sve·Ari / 04·60-10
8. 14·Sve-Eci / 05-45-10
9. 4-Cna-Ari / .065-35-15
10. 4-Cna-Ari / .065·40-30
11. 14-Sve·Cna·Eci / .07-50·15-10
12. 4-Cna-Eci / .07·45·10

LEGEND

- Reach Boundory
- Watershed Boundary
- Land Use Boundary
- 6000 — Elevotian Contours in feet
- Phreatophytes
- L — Irrigated Hay or Pasture
- R — Rangeland

R.58 E. R.59 E.

R.55 E. R.56 E. R.57 E. R.54 E.

R.51 E. R.52 E. R.53 E.

T. 37 N. T. 36 N. T. 35 N. T. 34 N. T. 33 N. T. 32 N.

ELKO WATERSHED

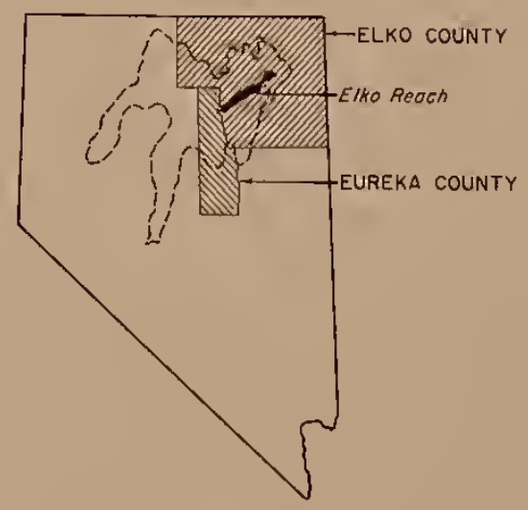
Mouse Mtn 7,466 · Adobe Summit · Nevada Youth Training Center · 7,505 Elko Mtn (Up River Peak) · 6,718 · Elko · 6,278 · Ryndon · Elburz · Halleck · Deeth · Hot Springs · Hunter · Moleen · Carlin · Marys Mtn. 7,703 · Buckskin Mtn. 6,690 · Grindstone Mtn. 7,384 · Palisade · Emigrant Pass

ADOBE RANGE · ELKO HILLS · EUREKA CO. · ELKO CO.

Sheep Cr. · Killdge · Eightmile Cr. · East Adobe Cr. · Jackstone Cr. · Sherman Cr. · Maggie Cr. · Susie Cr. · Marys · Warm Spring · Tonka · Woodruff · Pine Cr. · Humboldt R. · W. Fk Humboldt R. · Rabbit · Lamoille Cr. · Gaging Station · Carlin Spring (Owen)

U.S. 40 · NEV 43 · NEV 46 · NEV 200 · W P · S P L

LOCATION MAP



LAND USE AND PHREATOPHYTE MAP

ELKO REACH

HUMBOLDT RIVER BASIN SURVEY

ELKO & EUREKA COUNTIES, NEVADA

APRIL 1964

2 0 2 4 6
SCALE IN MILES

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